FUNCTIONAL ANALYSIS AND TREATMENT OF SEVERE PROBLEM BEHAVIOR MAINTAINED BY SOCIAL-NEGATIVE REINFORCEMENT

By

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Abstract

Functional analysis (FA) methodology is a robust technology for determining the function of severe problem behavior and developing effective function-based interventions. However, challenges exist in the assessment and treatment of severe problem behavior. Recent advances in FA methodology indicates that latency-based FAs might be an effective approach toward identifying functions of severe problem behavior. In addition, researchers have found that manipulating dimensions of reinforcement (e.g., magnitude and quality) during differential reinforcement of alternative behavior (DRA) for situations in which extinction (EXT) cannot be implemented is a potential approach for treating severe problem behavior. Specifically, studies have demonstrated that relative rates of appropriate behavior and problem behavior are a function of the relative value of reinforcement available for each response alternative. Therefore, there are multiple purposes of the current study. First, we replicated previous research by using the latency-based FA to determine the function of problem behavior (Study 1). Results showed that problem behavior was exclusively maintained by social-negative reinforcement for Anna, Janice, and Queenie and by social-negative reinforcement and social-positive reinforcement in the form of access to attention and tangible items for Brock. Second, we replicated and extended previous research by evaluating the effects of DRA without EXT for escape-maintained problem behavior (Study 2) by determining (a) the conditions under which DRA without EXT was effective for decreasing and maintaining low rates of problem behavior and (b) whether intervention effects would maintain while the token exchange schedule for the alternative response (i.e., compliance) was thinned. Results showed that effective treatments were developed in the absence of EXT by manipulating the magnitude and quality of

reinforcement for compliance for all four participants, and results maintained when reinforcement schedules were thinned with the use of tokens for three of the four participants.

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Functional Analysis and Treatment of Severe Problem Behavior Maintained by Social-Negative Reinforcement

Individuals with intellectual and developmental disabilities (IDD) often have severe problem behavior that include physical aggression, self-injurious behavior (SIB), property destruction, pica, and elopement (National Institutes of Health, 1991). These problem behaviors may result in danger or injury to oneself, others, or the environment and often lead to various challenges for the individual, their caregivers, and society (Doehring, Reichow, Palka, Phillips, & Hagopian, 2014; Kahng, Iwata, & Lewin, 2002; Lloyd & Kennedy, 2014; Luiselli, 2012; Taylor, Oliver, & Murphy, 2011). For this reason, the development of effective and efficient methodologies that lead to the treatment of severe problem behavior is an important national health concern (National Institutes of Health, 1991).

Functional Analysis of Severe Problem Behavior

Systematic functional analysis (FA) methodology emerged in the 1980s and has become the gold standard for determining the conditions under which problem behavior occurs and for deriving effective function-based interventions (Hagopian, Dozier, Rooker, & Jones, 2013; Hanley, 2012; Hanley, Iwata, & McCord, 2003; Iwata & Dozier, 2008; Lloyd & Kennedy, 2014). In fact, FA methodology has become the prominent assessment procedure for determining the function of problem behavior as evidenced by 981 distinct FAs of problem behavior having been published in 435 FA studies as of 2012 (Beavers, Iwata, & Lerman, 2013). In addition, various methodological and procedural extensions of FA methodology have resulted in a more improved and refined methodology (see Beavers et al., 2013 and Hanley et al., 2003 for a detailed discussion of these modifications as well as the *JABA Special Issue* on FA methodology, 2013, volume 46, issue 1).

Despite an overwhelming amount of empirical support for the use of FA methodology in the assessment and treatment of problem behavior, clinicians sometimes avoid its use due to various potential challenges (Desrochers, Hile, & Williams-Mosely, 1997; Ellingson, Miltenberger, & Long, 1999; Oliver, Pratt, & Normand, 2015; Roscoe, Phillips, Kelly, Farber, & Dube, 2015; Weber, Killu, Derby, & Barretto, 2005). These challenges include the (a) time needed to conduct the FA, (b) expertise needed to conduct the FA and analyze the data, (c) potential difficulties associated with assessing topographies of problem behavior that do not lend themselves to typical FA procedures (e.g., problem behavior that is covert or occurs at low rates), (d) lack of an adequate setting or space to conduct the FA (e.g., no barren or padded room available), and (e) potential danger or harm associated with conducting FAs of severe problem behavior. Recently, researchers have attempted to address these and other challenges to FA methodology (see detailed reviews in Beavers et al., 2013 and Hanley, 2012). In particular, a major focus of recent research has been on increasing the safety and efficiency of FA methodology in the assessment of severe and potentially dangerous problem behavior (Beavers et al., 2013). That is, researchers have discussed the importance of assessing risk prior to conducting an FA of severe problem behavior to inform the use of procedural safeguards. Additionally, researchers have conducted various studies involving modifications to FA methodology in an attempt to increase the safety and efficiency of FAs.

Managing Risks with Procedural Safeguards

Because FAs are designed to evoke and reinforce the occurrence of problem behavior, the target individual and therapist are at risk for injury or harm (Betz & Fisher, 2011; Hanley et al., 2003; Smith & Churchill, 2002). Thus, several authors suggest conducting a risk assessment to determine whether the benefits associated with conducting an FA of severe problem behavior

outweigh the risks (Betz & Fisher, 2011; Iwata & Dozier, 2008; Fisher, Rodriguez, Luczynski, & Kelley, 2013; Neidert, Rooker, Bayles, & Miller, 2013). Furthermore, authors have suggested the importance of determining appropriate safety measures to reduce risks and maximize benefits in conducting an FA with a particular individual (Betz & Fisher, 2011; Iwata & Dozier, 2008; Neidert, Rooker, et al., 2013; Weeden, Mahoney, & Poling, 2010).

For instance, assessment of potential risk includes asking questions about (a) the utility of alternative assessment procedures in lieu of conducting an FA, (b) whether the severe problem behavior will be more intense in or out of the assessment, and (c) whether the occurrence of the severe problem behavior will result in injury (Hanley, 2012). Typically, a cost-benefit analysis is recommended to consider the short- and long-term danger of ineffective treatment versus the potential harm that may occur during the course of an FA. Although recent findings suggest FA of SIB is relatively safe (Kahng et al., 2015), it is recommended that clinicians and researchers implement procedural safeguards and methodological modifications to decrease the likelihood of injury or harm associated with the occurrence of severe problem behavior.

Based on the outcomes of the risk assessment, the perceived danger and risk associated with the occurrence of the severe problem behavior will allow clinicians and researchers to determine whether to implement procedural safeguards to ensure the safest assessment possible. Common procedural safeguards include (a) oversight by appropriate professionals (medical professionals and Board Certified Behavior Analysts [BCBAs]) and use of (b) safety standards, (c) response blocking, and (d) protective equipment (Fisher et al, 2013; Hanley, 2012). First, to the extent possible, clinicians and researchers should consider medical evaluation and professional oversight to determine whether they should conduct a behavioral assessment, to provide ongoing evaluation of potential risk or injury, and to determine when FA sessions should

be terminated. Another professional that should be involved in the development and implementation of an FA is a BCBA with expertise in FA methodology and function-based intervention and experience managing severe problem behavior. That is, the BCBA and therapists associated with the case should be trained to implement best practices to increase the safety of the individual and others involved (Hanley, 2012). In addition to professional oversight, clinicians and researchers should consider additional safety procedures when conducting FAs of severe problem behavior. These procedures include (a) modifications to the assessment environment to increase the safety of all individuals involved in the FA (e.g., padded surfaces and soft stimuli such as toys), (b) a system for preventing escalation of severe problem behavior (e.g., development of session-termination criteria; see Betz & Fisher, 2011 and Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994 for examples), and (c) a system for ongoing monitoring of potential injuries (e.g., use of SIT Scale; Iwata, Pace, Kissel, Nau, & Farber, 1990; see Appendix A). Additional procedures include (a) the presence of trained staff who are able to provide first aid for minor injuries, (b) the use of blocking procedures (see Reed, Luiselli, Miller, & Kaplan, 2013 for a detailed description), and (d) the use of protective equipment used by the target individual or staff (see Fisher et al., 2013 for a detailed description) to protect the individual and others from harm. Overall, various professionals should be involved in the design, implementation, and oversight of FAs of severe problem behavior to promote the safest assessment process possible for determining the environmental determinants of the target problem behavior.

Modifications to FA Methodology

Although clinicians and researchers can use procedural safeguards to decrease the risks associated with FAs of severe problem behavior, researchers have also focused on modifications

to FA methodology that are likely to be safer and more efficient. These modifications include (a) decreasing the duration of FA sessions or the overall assessment, (b) conducting FAs of less severe problem behavior that is hypothesized to be in the same response class as the more severe problem behavior (i.e., precursor FA), and (c) using latency measures rather than repeated measures as an index of response strength to determine the function of problem behavior (i.e., latency-based FA).

Duration of FA. Researchers have made various modifications to FA methodology in an attempt to shorten session duration or the overall time needed to complete the assessment. For instance, researchers have evaluated the efficacy and efficiency of FAs that include (a) single-session conditions (e.g., Derby et al., 1992; Northup et al., 1991), (b) single-function tests (e.g., Hanley, Jin, Vanselow, & Hanratty, 2014; Iwata, Duncan, Zarcone, Lerman, & Shore, 1994; Querim et al., 2013), (c) shorter session durations (Wallace & Iwata, 1999), and (d) trial-based FAs (e.g., Bloom, Iwata, Fritz, Roscoe, & Carreau, 2011; Sigafoos & Saggers, 1995).

In one of the first studies to decrease the overall duration of FAs, Northup et al. (1991) developed and evaluated a "brief FA" that includes all test conditions and a control condition; however, the experimenters conducted only single sessions of each condition. Once a particular test condition produces high levels of problem behavior, either replications of this test condition or a contingency reversal (i.e., the putative reinforcer is delivered for appropriate behavior but no longer for problem behavior) are conducted in an attempt to replicate the effects or validate the results (Derby et al., 1992). Although results of research on brief FAs have shown it to be more effective than other assessment procedures, there are limitations to the brief FA method which are likely due to the lack of repeated exposure and repeated measures which are inherent in the brief FA design (Hanley, 2012; for a systematic review of the published research on brief FAs,

see Lydon, Healy, O'Reilly, & Lang, 2012). Another method to decrease overall FA duration is to decrease the number of sessions conducted by arranging for only a subset of test or control conditions. Three procedural variations of this "single-function test" includes (a) a pairwise analysis (Iwata & Dozier, 2008; Iwata, Duncan, et al., 1994), (b) a screening assessment (Querim et al., 2013; Vollmer, Marcus, Ringdahl, & Roane, 1995; Vollmer, Marcus, & LeBlanc, 1994), and (c) a synthesized contingency analysis (Hanley et al., 2014). Single-function tests may be an efficient FA methodology if preliminary information from indirect and descriptive assessments strongly suggest a source of reinforcement for the problem behavior (Iwata & Dozier, 2008). However, the primary limitation of this method relates to the potential of committing either a Type I or Type II error (Baer, 1977; Kazdin, 2011). Wallace and Iwata (1999) compared the results of FAs with different session durations (5 min vs. 10 min vs. 15 min) and showed the outcomes for 10- and 15-min sessions were identical and differences were observed between 5- and 15-min sessions in only a few of the cases. Based on these results, recommendations for best practice, particularly in the assessment of severe problem behavior, is to start with briefer, 5-min sessions and extend session duration if repeated exposure does not produce clear FA results (Betz & Fisher, 2011). A final method for decreasing FA duration involves the use of test and control trials in a trial-based FA (TBFA; e.g., Austin, Groves, Reynish, & Francis., 2015; Berg et al., 2007; Bloom et al., 2011; Kodak, Fisher, Paden, & Dickes, 2013; LaRue et al., 2010; Rispoli, Davis, Goodwyn, & Camargo, 2013; Sigafoos & Saggers, 1995; Wallace & Knights, 2003). TBFAs are typically conducted within the context of ongoing activities and tasks and involve a discrete-trial format in which clinicians and researchers conduct brief trials (3 to 7 min in duration) that include a test segment and a control segment to test potential reinforcers for problem behavior. Although TBFAs provide a simple, convenient, efficient, and relatively

effective method for determining the function of problem behavior, several potential disadvantages of this approach exist. First, the short trial durations of TBFAs result in minimized exposure to the putative EO, which may be insufficient for evoking problem behavior (Bloom et al., 2011; Rispoli et al., 2013). Second, 40% of TBFAs conducted in previous studies did not result in accurate predictions of the function of problem behavior and extended analyses were required to determine the variables responsible for maintaining problem behavior (Rispoli et al., 2013).

Precursor FA. In addition to various methods for decreasing the duration of FAs, conducting an FA of a precursor behavior that reliably precedes the severe problem behavior presents another option for minimizing risks associated with FAs of severe problem behavior (Dracobly & Smith, 2012; Smith & Churchill, 2002). This recommendation is based on the research on response-class hierarchies (Baer, 1982; Halle & Drasgow, 2003; Harding et al., 2001; Lalli, Mace, Wohn, & Livezey, 1995; Richman, Wacker, Asmus, Casey, & Andelman, 1999; Shabani, Carr, & Petursdottir, 2009), which suggests that potentially less severe or problematic behavior (e.g., whining, crying, fidgeting, yelling) often precedes severe problem behavior and is part of the same functional response class. Thus, FAs of the precursor behavior should allow one to infer the function of the severe problem behavior based on the outcome of the FA of the precursor behavior. Although preliminary research on precursor FAs suggest it is a valid method for determining the function of problem behavior and for deriving effective function-based interventions, there are two primary limitations associated with precursor FA methodology. First, researchers have yet to determine the most efficient and effective strategy for identifying precursors to severe problem behavior (Lydon et al., 2012). In addition, the current methods suggested for identifying precursors include the production of severe problem

behavior (e.g., Smith & Churchill, 2002) or are too technical and time-consuming for clinicians to implement (e.g., conditional probabilities and lag-sequential analyses; Borrero & Borrero, 2008). Second, there may be individuals who display severe problem behavior that do not present any identifiable precursor behaviors, making this approach irrelevant for such cases.

Latency-based FA. A final method for reducing the frequency of problem behavior during FA sessions involves using a measure of latency to the first occurrence of problem behavior (e.g., Neidert, Iwata, Dempsey, & Thomason-Sassi, 2013; Thomason-Sassi, Iwata, Neidert, & Roscoe, 2011) rather than repeated measures (i.e., rate, duration) of the problem behavior. For instance, during each latency-based FA session, the observer records the period of time that elapses from the beginning of the session to the first occurrence of problem behavior. In addition, the therapist delivers the programmed consequence and terminates the session once the problem behavior occurs. Thus, conditions in which shorter latencies to the first occurrence of problem behavior are observed as compared to control conditions suggest variables that maintain problem behavior.

Although a common characteristic of FA methodology involves repeatedly evoking problem behavior within a session to determine response strength under various environmental conditions, previous research (Killeen & Hall, 2001; LaRue et al., 2010; Thomason-Sassi et al., 2011) suggests that response latency may also be a good measure of response strength. In a recent study, Thomason-Sassi and colleagues (2011) demonstrated that response latency is a valid measure for problem behavior during FAs. In one experiment, the researchers created two separate graphs for 38 previously conducted FAs using repeated measures. In one graph, the researchers graphed the latency to the first occurrence of the target problem behavior using the data streams for each session and used the original response repetition measure (i.e., rate) in the

other graph. Comparisons of the two graphs for each problem behavior showed correspondence on the function of problem behavior for 33 out of 38 data sets (87%). In a second experiment, the researchers conducted one latency-based FA and one rate-based FA on the problem behavior displayed by 10 participants. Results showed correspondence (the same function) between the two FAs for 9 out of 10 participants. Additionally, the results of this study showed that when compared to FAs conducted using a rate measure, fewer instances of problem behavior were required during latency-based FAs to determine the function of problem behavior. Overall, these data suggest response latency may be a viable measure for target behavior during FAs. Furthermore, because this measure requires fewer instances of problem behavior and results in a potentially shorter duration FA, this methodology may be quite useful for increasing the safety of conducting FAs of severe problem behavior.

Furthermore, latency FAs have several other potential advantages. First, the use of a latency measure in FAs may avoid the potential confounds from the use of blocking or wearing protective equipment during FAs (e.g., extinction of automatically reinforcing problem behavior; Neidert, Rooker, et al., 2013). Second, a latency measure may be useful in situations in which the occurrence of the severe problem behavior (e.g., elopement and property destruction) makes it difficult to restore the original environmental condition such that behavior can recur within session without introducing a potential confound (Neidert, Rooker, et al., 2013). For example, elopement cannot recur without repeatedly returning an individual to the original location each time it occurs, which may introduce extraneous variables that interfere with the determination of the function of problem behavior. In a recent study, Neidert, Iwata, and colleagues (2013) conducted a latency-based FA for two participants who engaged in elopement. Results showed

the latency FA identified the functions of elopement for the two participants, which led to effective function-based treatments.

Although there are several advantages to the use of latency-based FAs, there are also some potential limitations. First, because sessions are terminated contingent upon the first occurrence of problem behavior, this approach limits an individual's exposure to the number of sessions and types of session contingencies, which may interfere with discrimination of session contingencies (Thomason-Sassi et al., 2010). However, the use of procedural strategies to enhance discrimination of the different conditions (e.g., condition signaling stimuli or designs such as the pairwise design) might be helpful to address this limitation (Neidert, Iwata, et al., 2013; Neidert, Rooker et al., 2013). Second, because there are no repeated measures within a session, this precludes additional within-session analyses that can be useful for clarifying functions of problem behavior (Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993). Third, certain EOs might require more exposure than others before their influence evokes problem behavior (e.g., instructional context may not become aversive until demands are presented for 10 consecutive min). Finally, although the evidence available supports the validity of the latency-based FA (Wightman, Julio, & Virués-Ortega, 2014), this evidence is limited in that the generality of the methodology has not been evaluated and only a handful of studies with a few participants have validated the outcomes of latency-based FAs with function-based interventions.

DRA as Treatment for Problem Behavior Maintained by Social-Negative Reinforcement

Previous research has suggested that approximately 35% of problem behavior is maintained by social-negative reinforcement (e.g., escape from aversive events such as demands; Beavers et al., 2013) and various function-based interventions have been effective in decreasing the occurrence of these problem behaviors. Effective interventions include the use of escape

extinction (EXT; Lerman & Iwata, 1996; Vollmer & Athens, 2011), differential reinforcement (Tiger, Hanley, & Bruzek, 2008; Vollmer & Iwata, 1992), and several antecedent interventions (Carr et al., 2000; Carr & LeBlanc, 2006; Geiger, Carr, & LeBlanc, 2010; Smith, 2011).

A common type of differential reinforcement intervention for problem behavior maintained by social-negative reinforcement is differential reinforcement of alternative behavior (DRA; Petscher, Rey, & Bailey, 2009). This intervention involves the delivery of escape contingent on the occurrence of an appropriate alternative response while no longer delivering the functional reinforcer for the occurrence of problem behavior (i.e., escape EXT; Durand & Carr, 1991; Lalli, Casey, & Kates, 1995; Vollmer & Iwata, 1992). Appropriate alternative responses for problem behavior maintained by social-negative reinforcement may include either compliance to access escape (e.g., Vollmer, Roane, Ringdahl, & Marcus, 1999) or a communicative response (i.e., Functional Communication Training [FCT]; for a review, see Tiger et al., 2008) to access escape (e.g., Horner & Day, 1991; Lalli, Casey, et al., 1995) or help with a difficult task (e.g., Carr & Durand, 1985). Escape EXT may involve the nonremoval of the aversive stimulus (e.g., Mace, Browder, & Lin, 1987; Piazza, Patel, Gulotta, Sevin, & Layer, 2003) or guided compliance (e.g., Iwata, Pace, Kalsher, et al., 1990; Zarcone, Iwata, Hughes, & Vollmer, 1993). It is important to note that most research suggests that EXT is an important, and often necessary, component of DRA procedures (e.g., Fisher et al., 1993; Hagopian, Fisher, Sullivan, Acquisto, & LeBlanc, 1998; McCord, Thomson, & Iwata, 2001). For example, Hagopian et al. (1998) found that a predetermined session criterion of 90% reduction in problem behavior was not achieved with any of 11 participants who experienced FCT without EXT. However, FCT with EXT produced a 90% reduction in problem behavior for 11 of 25

applications and FCT with punishment produced a 90% reduction in problem behavior for all 17 applications.

Challenges Associated with EXT

Although EXT is often a critical component of DRA procedures (as well as other function-based interventions), there are potential challenges associated with the implementation of EXT that sometimes make it difficult or impossible to implement, particularly for instances of severe problem behavior (Athens & Vollmer, 2011; Piazza, Moes, & Fisher, 1996). Challenges include potential side effects of EXT and the potential danger of implementing EXT under various conditions. Both sets of challenges may lead to dangerous levels of severe problem behavior, problems with treatment integrity, or both. In fact, the use of EXT in the treatment of severe problem behavior may not even be feasible due to these concerns (Hagopian et al., 2013).

Potential negative side effects of EXT may include (a) EXT bursts (Iwata, Pace, Kalsher, et al., 1990; Zarcone, Iwata, Hughes, et al., 1993), (b) EXT-induced response variability, which may result in new forms of problem behavior (Goh & Iwata, 1994; Lennox, Miltenberger, & Donnelly, 1987), (c) EXT-induced aggression (Todd, Morris, & Fenza, 1989), (d) emotional behavior such as crying and screaming (Cowdery, Iwata, & Pace, 1990), and (e) spontaneous recovery (Lerman, Kelley, Van Camp, & Roane, 1999). Reviews of the literature suggest these negative side effects are perhaps not as common as once believed; however, some (e.g., response bursts) are more likely to be reported with escape-maintained problem behavior (Lerman & Iwata, 1995; Lerman & Iwata, 1996; Lerman, Iwata, & Wallace, 1999). Additionally, although a review of the research suggests most of these side effects are attenuated when EXT is combined with reinforcement-based procedures such as DRA (Lerman & Iwata, 1995; Lerman, Iwata, et al., 1999), any occurrence of these side effects are undesirable in the treatment of severe problem

behavior. That is, these side effects will likely produce compromised treatment integrity, resulting in intermittent reinforcement of problem behavior, thus leading to a potential risk for the increased rate or intensity of this severe behavior. Further, as discussed above, any increase in the frequency or intensity of dangerous or harmful instances of severe problem behavior poses a multitude of safety concerns.

In addition to potential negative side effects, EXT may not be feasible to implement as a procedure under various situations (Pace, Ivancic, & Jefferson, 1994; Piazza et al., 1996). For example, escape EXT may not be possible if the individual is large, combative, or engages in high-magnitude problem behavior. That is, it may be physically impossible or unsafe for the caregiver to physically prompt or block instances of the severe problem behavior while attempting to continue with the demand or exposure to the aversive context (Vollmer & Athens, 2011).

A Framework for Enhancing the Efficacy of DRA without EXT

Given the challenges associated with EXT, researchers have begun to evaluate the effects of various manipulations for enhancing the efficacy of DRA without EXT for problem behavior maintained by social reinforcement (e.g., Athens & Vollmer, 2010; Fisher et al., 1993; Hagopian et al., 1998; Hoch, McComas, Thompson, & Paone, 2002; Horner & Day, 1991; Lalli & Casey, 1996; Lalli et al., 1999; Parrish et al., 1986; Piazza et al., 1997; Piazza et al., 1999; Shirley et al., 1997; Vollmer et al., 1999; Worsdell, Iwata, Hanley, Thompson, & Kahng, 2000). To understand how these manipulations may work, DRA is often conceptualized as a concurrent-operants arrangement (Athens & Vollmer, 2010; Fisher et al., 1993; Fisher & Mazur, 1997; Mace & Roberts, 1993) in which the occurrence of problem behavior and appropriate replacement behavior are two concurrently available but distinct response options (or, “choices”;

Borrero & Vollmer, 2002; Fisher & Mazur, 1997; Mace & Roberts, 1993; Myerson & Hale, 1984). Thus, in such arrangements, the individual allocates responding across response options based on the response requirement and value of the reinforcement delivered for those available response options (Ferster & Skinner, 1957; Fisher & Mazur, 1997). Most researchers have found DRA without EXT in which the outcome for problem behavior and appropriate behavior are equivalent (e.g., both responses result in 30-s escape), often results in allocation of higher rates of responding toward problem behavior than appropriate behavior (Fisher et al., 1993; Hagopian et al., 1998). However, based on previous basic, translational, and applied studies (e.g., Baum, 1979; Catania, 1963; Chung, 1965; Davison & McCarthy, 1988; Mace, Neef, Shade, & Mauro, 1994; McDowell, 1988; Neef, Mace, & Shade, 1993; Reed & Martens, 2008), researchers have begun to manipulate dimensions of responding or reinforcement to influence responding toward the appropriate response alternative as compared to problem behavior. Under this framework, lower effort for engaging in the appropriate behavior as compared to the problem behavior or a more valuable reinforcer (e.g., higher rate, less delayed, larger magnitude, and higher quality) for appropriate behavior as compared to the reinforcer for problem behavior is presumed to result in higher levels of appropriate alternative behavior and lower levels of problem behavior.

Dimensions of Responding and Reinforcement in DRA without EXT for Problem Behavior Maintained by Social-Negative Reinforcement

Several studies have shown DRA without EXT for problem behavior maintained by social-positive reinforcement was effective when experimenters manipulated various response and reinforcement dimensions. That is, researchers have shown that DRA without EXT is effective when the effort to obtain positive reinforcement was less for the alternative behavior as compared to the problem behavior (Richman, Wacker, & Winborn, 2000). In addition, they have

shown that DRA without EXT is effective when the rate of positive reinforcement (Borrero et al., 2010; Kelley, Lerman, & Van Camp, 2002; Worsdell et al., 2000; Vollmer et al., 1999), delay to positive reinforcement (Athens & Vollmer, 2010), magnitude of positive reinforcement (Athens & Vollmer, 2010), and quality of positive reinforcement (Athens & Vollmer, 2010; Piazza et al., 1999) favored the alternative response as compared to problem behavior. Finally, researchers have manipulated combinations of these dimensions for problem behavior maintained by social-positive reinforcement and found similar and sometimes more robust effects (e.g., Athens & Vollmer, 2010; Peck et al., 1996; Vollmer, Borrero, Lalli, & Daniel, 1999). However, researchers have conducted fewer studies on the effects of these dimensions within DRA without EXT for problem behavior maintained by social-negative reinforcement.

Response effort, schedule of reinforcement, and delay to reinforcement. Horner and Day (1991) conducted one of the first systematic series of studies to evaluate the influence of response and reinforcer dimensions under conditions of DRA without EXT for problem behavior that the experimenters hypothesized was maintained by social-negative reinforcement. The experimenters evaluated the effects of physical effort of the response (Study 1), schedule (or rate) of reinforcement (Study 2), and delay between presentation of the discriminative stimulus and delivery of reinforcement (Study 3) with three participants (one in each study) living in a community residential support program. In Study 1 (evaluation of physical effort), the experimenters systematically manipulated the amount of effort required to engage in an FCT response. The participant was a 12-year-old boy diagnosed with severe mental retardation who engaged in high levels of escape-maintained SIB and aggression. In the initial phase, problem behavior and compliance both resulted in escape on a fixed-ratio (FR) 1 schedule; results showed that responding favored compliance over problem behavior. In the next phase, the experimenters

increased the effort to access the break for compliance to an FR 15 schedule, and the participant's problem behavior increased and attempted compliance decreased substantially. Next, the experimenters taught the participant to sign using a full sentence (i.e., "I want to go, please.") and a sign using a relatively less effortful single word (i.e., "break") to request a break from the work task. Next, the experimenters compared the effects of two different conditions. In the first condition, the participant could either sign the full sentence or engage in a single instance of problem behavior to obtain access to the break. In the second condition, the participant could either sign the single word or engage in a single instance of problem behavior to obtain access to the break. Levels of problem behavior were much higher during the phases in which the participant was required to sign a full sentence than during phases in which the participant was required to sign the single word. These results provide evidence that effort to obtain reinforcement is a relevant dimension to consider when programming reinforcement contingencies within a concurrent-operants arrangement for escape-maintained problem behavior.

In Study 2, Horner and Day (1991) investigated the influence of the relative rate of reinforcement for mands and problem behavior. The participant was a 14-year-old male who was diagnosed with profound mental retardation. Following a brief assessment to confirm the participant's problem behavior was maintained by gaining access to help from the experimenter, the participant was taught to sign, "help" to access experimenter help. Response allocation between this mand and problem behavior was evaluated when both were reinforced on an FR 1 schedule of reinforcement. In this condition, response allocation was largely in favor of signing, "help." Next, the experimenter reinforced mands on an FR 3 schedule while they continued to reinforce problem behavior on an FR 1 schedule. Results in this condition showed much higher

rates of problem behavior. This particular study highlights the importance of the schedule of reinforcement and illustrates the relative rate at which a response results in reinforcement for a given behavior can influence response allocation.

In Study 3, Horner and Day (1991) examined the influence of delay to reinforcement in a concurrent-operants arrangement for mands for break and problem behavior. The participant was a 27-year-old female diagnosed with autism and severe mental retardation. To analyze the effects of delay to reinforcement on response allocation between mands for break and problem behavior, the experimenters implemented two conditions within a reversal design. In one condition, the experimenters provided the participant with a break immediately after she engaged in the mand (i.e., 1-s delay); in the other condition, the experimenters provided the participant with a break 20 s after she engaged in the mand. In both conditions, problem behavior produced an immediate break. High levels of problem behavior were demonstrated when mands produced a 20-s delay to break. In contrast, during the 1-s delay condition (when the delay to reinforcement was equal for the mand and problem behavior), the participant's problem behavior was low and use of the mand was high. This study demonstrates the influence that delay to reinforcement has on response allocation in a concurrent schedule arrangement. In addition, this research illustrates the importance of considering delay to reinforcement when designing an intervention for problem behavior in the absence of an EXT component.

Overall, Horner and Day showed that response effort, schedule of reinforcement, and delay to reinforcement with three different participants were influential dimensions on the allocation of responding across appropriate replacement behavior and problem behavior. Thus, these evaluations demonstrated an initial approach toward manipulating response and reinforcement dimensions to favor appropriate responding. However, limitations of the study are

that the experimenters conducted each evaluation with only one participant and it was unclear what variables were maintaining problem behavior for participants because no formal FAs were conducted.

Lalli and Casey (1996) investigated the effects of varying schedules of reinforcement within a concurrent-operants arrangement with a 6-year-old boy diagnosed with mild developmental delays. Results of the FA suggested the participant's aggression was sensitive to escape from task demands, access to attention, and access to tangibles. During baseline, problem behavior resulted in a 30-s break on a variable-ratio (VR) 5 schedule, whereas compliance resulted in praise on a FR 1 schedule and a 30-s break on a VR 5 schedule. Results showed high levels of problem behavior and low levels of compliance. The first treatment condition was similar to baseline, except compliance resulted in a 30-s break on an FR 1 schedule and problem behavior continued to result in a 30-s breaks on a VR 5 schedule. This treatment phase resulted in an increase in compliance and overall decrease in problem behavior. However, these effects did not maintain when the experimenters thinned the schedule of reinforcement for compliance. Thus, additional manipulations were required to show robust effects.

In a recent study, Athens and Vollmer (2010) evaluated the influence of various isolated and combined dimensions of reinforcement on appropriate behavior and problem behavior maintained by social reinforcement. However, they only conducted a few manipulations with participants whose problem behavior was maintained by social-negative reinforcement. In Experiment 3 of their study, the experimenters manipulated delay to reinforcement with one participant (Henry) whose problem behavior was maintained by escape from demands. Henry was exposed to experimental arrangements in which appropriate behavior (i.e., mand for escape) and problem behavior both produced a 0-s delay to a 30-s break. During the next phase, Henry

was exposed to the first manipulation in the 0-s/30-s delay condition in which appropriate behavior (i.e., mand for escape) produced an immediate, 30-s break and problem behavior resulted in a 30-s break following a 30-s unsignaled delay. Finally, in the next phase (0-s/60-s delay), the experimenters implemented a more discrepant condition in which appropriate behavior resulted in an immediate, 30-s break and problem behavior resulted in a 30-s break from instruction following a 60-s unsignaled delay. Results for Henry indicated that during the 0-s/0-s delay baseline, he engaged in higher rates of problem behavior than appropriate behavior. During the 0-s/30-s delay condition, he continued to engage in higher rates of problem behavior as compared to appropriate behavior. However, once the experimenters introduced the 0-s/60-s delay condition, Henry displayed a decrease in problem behavior to zero rates and an increase in appropriate behavior. The experimenters replicated these results using a reversal design. Although results showed delay to reinforcement was an influential dimension of reinforcement on the allocation of responding across appropriate replacement behavior and problem behavior, only a few manipulations were conducted with one participant whose problem behavior was maintained by social-negative reinforcement. Therefore, further replications are needed before conclusions regarding delay to reinforcement as an influential dimension for treatment using DRA without EXT.

Magnitude of reinforcement. Athens and Vollmer (2010) provide the only demonstration of a systematic manipulation of magnitude of reinforcement in a concurrent arrangement for the treatment of problem behavior maintained by social-negative reinforcement in the absence of EXT. In Experiment 1 (magnitude [duration of reinforcement] manipulation), one participant (Justin) whose problem behavior was maintained by social-negative reinforcement participated. Results for Justin indicated that during the baseline condition in

which appropriate behavior (i.e., compliance) and problem behavior both produced a 30-s break from instructions, problem behavior occurred at higher rates than appropriate behavior. In the 30-s/10-s duration condition in which compliance produced a 30-s break from instructions and problem behavior produced only a 10-s break, Justin displayed a slight decrease in the rate of problem behavior and a slight increase in compliance. Because problem behavior still occurred within this phase, the experimenters implemented a more discrepant condition (45 s/5 s duration) in which compliance resulted in a 45-s break and problem behavior only resulted in a 5-s break, which resulted in an increase in compliance and decrease in problem behavior over the last five sessions. The experimenters replicated these patterns of responding in subsequent reversals. Interestingly, in the final reversal to 30-s/30-s baseline conditions, problem behavior remained low and compliance maintained at high rates, demonstrating a failure to replicate previous baseline levels of responding. Overall, the duration manipulation indicated that relative rates of problem behavior and compliance were sensitive to the reinforcement duration available for each alternative in which duration of reinforcement was unequal across four out of five applications. These results replicate the findings of previous investigations on the effects of reinforcement duration on choice responding (Catania, 1963; Lerman, Kelley, Vorndran, Kuhn, & LaRue, 2002; Ten Eyck, 1970). Although the results were interesting, there are some limitations to consider. First, only one participant whose behavior was maintained by social-negative reinforcement was exposed to this manipulation. Therefore, more participants are needed to replicate these findings. In addition, the experimenters were unable to recapture baseline rates of problem behavior and compliance in the final reversal to baseline. This failure was likely a result of the participant's recent exposure to the conditions in which reinforcement favored

appropriate responding. This lack of replication weakens the demonstration of experimental control and additional replications both across and within participants are needed.

Quality of reinforcement. Most research on manipulation of dimensions of reinforcement in DRA without EXT for problem behavior maintained by social-negative reinforcement has involved manipulation of quality of reinforcement. In these studies, researchers have manipulated quality in one of two ways. The first is by providing an "enhanced" escape period in which access to preferred stimuli such as edibles, attention, or toys are provided for appropriate behavior (mand or compliance; Athens & Vollmer, 2010; Hoch et al., 2002; Lalli & Casey, 1996; Piazza et al., 1997). The second is by providing brief access to positive reinforcers (e.g., edibles) contingent upon compliance without a programmed break period (e.g., Adelinas et al., 2001; Carter, 2010; DeLeon et al., 2001; Lalli et al., 1999; Slocum & Vollmer, 2015).

Enhanced escape for alternative response. After treatment effects with manipulation of the schedule of reinforcement for one participant failed to maintain when the schedule of reinforcement was thinned for compliance, Lalli and Casey (1996) enhanced the quality of the break by including preferred adult attention contingent on compliance. Attention during the breaks consisted of the experimenter modeling appropriate toy play and providing physical contact (e.g., high fives and tickles). The enhanced quality condition, or combination of attention and a break, resulted in higher levels of compliance and lower levels of aggression, even while the schedule of reinforcement for compliance was thinned to an FR 10 and problem behavior continued to result in the functional reinforcer on a VR 5 schedule. Results of this study demonstrate that if schedules of reinforcement for multiple, concurrently available response options are carefully arranged, interventions may preclude the use of EXT. Further, for

the participant in this study, the enhanced condition produced increases in appropriate behavior that maintained throughout reinforcement thinning, even in the absence of EXT. One possible explanation for these results is that the problem behavior appeared to be sensitive to both escape and attention. Thus, when compliance resulted in both attention and escape and problem behavior only resulted in escape, enhanced effects were observed. Although results were robust, it is unknown whether the experimenters could have thinned the schedule of reinforcement for compliance while maintaining low levels of problem behavior.

Piazza et al. (1997) further examined the effects of providing both negative and positive reinforcement for three children who displayed problem behavior. Initial FA outcomes for all three participants indicated that problem behavior was maintained by multiple sources of reinforcement. However, escape from instructional demands was consistent across all FA outcomes for all three participants. Therefore, Piazza and colleagues systematically evaluated the effects of reinforcing compliance with one, two, or three of the reinforcing consequences (a break, tangible items, attention), when problem behavior produced a break and when it did not (escape EXT). For two of the three participants, access to preferred stimuli produced the highest levels of compliance even when problem behavior produced escape. In addition, when compliance resulted in access to preferred stimuli, the schedule of reinforcement was thinned quicker and fewer instances of problem behavior occurred. The authors suggested one potential explanation for these findings is the relative rates of appropriate behavior and problem behavior were a function of the relative value of the reinforcement produced by escape. However, it is not clear whether the intervention would be effective with individuals whose problem behavior was sensitive to escape only. In addition, only functional reinforcers that were demonstrated to maintain problem behavior during the pretreatment FA were added to enhance the break

condition; however, it is unknown whether incorporating multiple alternative reinforcers that are identified through a preference or reinforcer assessment might produce similar or more robust treatment effects. Further, although reinforcement schedule thinning in the form of demand fading was minimally effective, the terminal treatment goal of 20 demands was not met for any of the three participants.

Hoch and colleagues (2002) conducted a parametric analysis of DRA without EXT with two participants who engaged in problem behavior maintained by social-negative reinforcement. Similar to previous studies, these researchers found when both problem and appropriate behavior produced an equivalent break from tasks, problem behavior for each participant occurred at high rates and few tasks were completed. In contrast, when problem behavior produced a break and task completion produced both a break and access to preferred activities, problem behavior was eliminated and task completion increased. These effects were maintained when the response requirement was increased and the reinforcement schedule was thinned. However, one limitation noted by the authors was the order of the experimental conditions. Specifically, the conditions in which both problem and appropriate behavior produced breaks never preceded conditions in which breaks followed problem behavior and breaks plus preferred activities followed appropriate behavior. Therefore, it is unknown whether an escape-alone condition would have been sufficient to decrease problem behavior had participants not had a history of escape with access to preferred activities for task completion. In addition, although the experimenters demonstrated maintenance of behavior change under conditions of increased response requirements and leaner schedules of reinforcement, the procedures for determining the increase in response requirement and duration of reinforcement were derived on an individual basis. This led to variations in schedule thinning procedures, thus making it difficult to interpret the relative

effectiveness of the varied maintenance components across participants. Therefore, a more systematic evaluation of an approach towards reinforcement schedule thinning during DRA without EXT is needed.

Most recently, Athens and Vollmer (2010) evaluated the influence of quality of reinforcement in Experiment 2 of their multi-experiment study on the influence of various isolated and combined dimensions of reinforcement. This quality manipulation was conducted with the same participant (Justin) that was in Experiment 1 in which the experimenters manipulated magnitude (duration) of reinforcement. As a reminder, Justin's problem behavior was only maintained by escape. During the baseline condition, in which compliance and problem behavior both produced a 30-s break from instructions with access to one high-quality tangible item (1 HQ/1 HQ baseline condition), Justin displayed higher rates of problem behavior than compliance. In the 1 HQ/1 LQ condition, in which compliance produced a 30-s break from instructions with access to one high-quality tangible item and problem behavior produced a 30-s break with access to one low-quality tangible item, there was a slight decrease in the rate of problem behavior and a slight increase in compliance. However, because problem behavior increased toward the end of this phase, the experimenters implemented a more discrepant condition. In this condition, compliance resulted in a 30-s break with access to three high-quality tangible items and problem behavior produced a 30-s break with access to one low-quality tangible item (3 HQ/1 LQ condition), which resulted in an increase in compliance and a decrease in problem behavior. The experimenters replicated these results in subsequent reversals. Interestingly, in the final reversal to the 1 HQ/1 HQ baseline condition, problem behavior occurred at variable rates and compliance maintained at high rates, demonstrating a failure to replicate previous baseline levels of responding. Therefore, because problem behavior

remained high and variable, the experimenters implemented the 3 HQ/1 LQ condition and were able to establish low rates of problem behavior and maintain high rates of appropriate behavior. Overall, results of the quality manipulation indicated for Justin, the relative rates of both problem behavior and compliance were sensitive to the quality of reinforcement available for each alternative. These results replicate the findings of previous investigations on the effects of reinforcement quality on choice responding. However, there are some limitations of the current application to consider. As in Experiment 1, the failure to replicate prior rates of appropriate behavior in the final reversal baseline weakened experimental control, likely due to a recent history with compliance resulting in higher quality reinforcers. Therefore, more replications are needed to demonstrate the validity of this effect.

Brief positive reinforcement for alternative response. Although research has demonstrated the enhanced break period is more effective at increasing alternative responding and decreasing problem behavior than a break alone, a limitation of these studies is that it is unclear whether it is necessary to provide escape for the alternative response or if reinforcing the alternative response with brief access to positive reinforcement (without a break period) would produce similar reductions in problem behavior. Therefore, researchers began to attempt to answer this question.

In an early study, Lalli et al. (1999) compared the effects of reinforcing compliance with either positive reinforcement (edible item) or negative reinforcement (a break) for five participants who displayed escape-maintained problem behavior. Across all five cases, results showed that compliance was higher and problem behavior was lower when compliance produced an edible item rather than a break, even when problem behavior continued to result in a 30-s break. Adelinas, Piazza, and Goh (2001) extended Lalli et al. (1999) by delivering edible

reinforcers following a communicative response and by applying the intervention to multiply controlled problem behavior (access to attention and escape from demands) in the absence of EXT, which resulted in robust treatment effects.

Carter (2010) further extended Lalli et al. (1999) by comparing the effects of escape EXT to the delivery of different positive reinforcers (i.e., high-preference edible item, low-preference edible item, or high-preference leisure item) for compliance in the absence of escape EXT with one participant. The delivery of high-preference edible or leisure items for compliance was more effective than the delivery of low-preference items or escape for compliance in reducing problem behavior and increasing compliance. Collectively, these studies demonstrate that treatments using positive reinforcers more effectively reduce problem behavior and increase compliance than do treatments that used only escape as a reinforcer.

Several studies have evaluated participants' choice for positive or negative reinforcers for compliance under conditions in which EXT is not implemented for problem behavior with individuals whose problem behavior is maintained by escape. For instance, DeLeon, Neidert, Anders, and Rodriguez-Catter (2001) examined the relative effects of positive and negative reinforcement for compliance (without EXT for problem behavior) on levels of compliance and escape-maintained problem behavior for one participant diagnosed with IDD. Results indicated that conditions in which a positive reinforcer (edible item) was delivered contingent on compliance produced the lowest levels of problem behavior and highest levels of compliance as compared to the condition in which a negative reinforcer (break) was delivered contingent on compliance. During the second analysis, EXT was implemented for problem behavior, and thus represents a potential limitation when interpreting the relative influence of positive or negative reinforcement for compliance. The authors examined potential changes in the relative value of

positive and negative reinforcement as a function of thinning the schedule of reinforcement. Under low work requirements, the participant chose to access an edible item while continuing to work. However, once the schedule requirements increased over time, the participant reallocated their choice for a break contingent on compliance. These results replicated previous research that has demonstrated the effectiveness of positive reinforcement in the treatment of escape-maintained problem behavior. Additionally, these results support previous findings suggesting positive reinforcement produces robust effects and is more preferred than negative reinforcement for compliance in the treatment of escape-maintained problem behavior under dense schedules of reinforcement (Lalli et al., 1999). The authors speculated the increasing work requirement established break from work as a more valuable reinforcer, thereby increasing the probability of behaviors that presently (choosing break) or historically (problem behavior) resulted in escape from work.

More recently, Gardner, Wacker, and Boelter (2009) evaluated whether the delivery of alternating qualities of attention (i.e., high-quality attention [HQA], low-quality attention [LQA], or no attention) could bias responding in favor of compliance with academic tasks for two boys with escape-maintained problem behavior, without the use of an EXT for problem behavior. Results demonstrated different qualities of attention provided across concurrent schedules could in fact bias responding towards compliance, despite the continuous availability of negative reinforcement. These results suggest that quality of attention may also be a dimension of positive reinforcement that can be a low-cost intervention component in the treatment of escape-maintained problem behavior in the absence of EXT. Although these initial results are promising, replications are needed and use of assessments to further isolate qualities of attention delivered by care providers would be beneficial.

Most recently, Slocum and Vollmer (2015) directly compared the delivery of functional (i.e., escape) and nonfunctional (i.e. edible) reinforcers for compliance in the treatment of escape-maintained problem behavior for five participants. The experimenters rapidly alternated implementation of a positive reinforcement condition and a negative reinforcement condition in which compliance resulted in a small edible item or a break from instructions, respectively. In addition, problem behavior also resulted in a break. Results suggested the delivery of a positive reinforcer for compliance was effective for treating escape-maintained problem behavior for all five participants, and the delivery of escape for compliance was ineffective for three out of the five subjects. Interestingly, FA results for the two participants who displayed the clearest treatment outcomes with the positive reinforcement conditions, showed that problem behavior was also maintained by positive reinforcement in the form of access to tangible items. Therefore, the positive reinforcers used within the treatment condition might not have been "nonfunctional." Furthermore, the tangible condition was not included in two participants' FAs, so it is unknown whether their problem behavior was also maintained by access to tangible items. Thus, it is possible that DRA without EXT in which compliance results in positive reinforcers may be more effective for individuals whose FA results identify both tangible and escape functions as compared to those individuals whose problem behavior is only maintained by escape.

Overall, previous research suggests the delivery of positive reinforcers contingent on compliance can reduce escape-maintained problem behavior, even in the absence of EXT (Payne & Dozier, 2013). In addition, this approach may be even more effective than the delivery of the functional reinforcer (i.e., escape), as long as the schedule of reinforcement remains dense (e.g., Carter, 2010; DeLeon et al., 2001). Although these studies have contributed to the growing body

of research in this area, there are several limitations that should be addressed. First, it was noted that problem behavior was maintained by both social-positive and social-negative reinforcement for several participants in a number of studies (e.g., DeLeon et al., 2001; Piazza et al., 1997). Therefore, positive-reinforcement based interventions may have been effective because problem behavior was also maintained by social-positive reinforcement, rather than the behavior being only maintained by social-negative reinforcement. Second, the design of several studies introduce potential order effects because positive reinforcement was always evaluated before negative reinforcement (e.g., Carter, 2010). Finally, the long-term effects of the procedures are also unknown and may become impractical for caregivers to maintain dense schedules of reinforcement. Thus, additional research should attempt to clarify the conditions under which these procedures can be thinned to practical levels.

Combined dimensions of reinforcement. Although several studies have shown the robust effects of combining dimensions of reinforcement under DRA without EXT for problem behavior maintained by social-positive reinforcement (e.g., Athens & Vollmer, 2010), only one study with one participant has evaluated the influence of combined dimensions for problem behavior maintained by social-negative reinforcement. During the initial schedule evaluation by Lalli and Casey (1996) described above, experimenters reinforced compliance on an FR1 schedule and problem behavior on a VR5 schedule, and both compliance and problem behavior resulted in a 30-s break with toys. Results of this manipulation showed an increase in compliance and a decrease in problem behavior for the participant; however, as the schedule of reinforcement was thinned, problem behavior increased. Therefore, the experimenters added preferred adult attention during the break for compliance and showed this enhanced break, under a denser schedule, was effective, even as the schedule was thinned. However, given the

maintained effects as the schedule was thinned and the fact that the participant's problem behavior was also maintained by attention, it is unclear whether it was necessary to combine schedule and quality manipulations. That is, it is possible these effects would have been observed even when the schedules of reinforcement for compliance and problem behavior were initially equal.

Limitations of Previous Research

Research evaluating DRA without EXT for problem behavior maintained by social-negative reinforcement has provided a potential approach toward effectively treating severe problem behavior. Specifically, DRA without EXT in which dimensions of responding or reinforcement are manipulated to influence response allocation toward an appropriate, alternative behavior rather than problem behavior hold promise. However, research in this area is limited and replications and extensions are needed. First, few studies have evaluated the effects of dimensions of reinforcement other than quality, including magnitude of reinforcement. Second, although previous researchers have found robust effects when combining dimensions of reinforcement for problem behavior maintained by social-positive reinforcement (e.g., Athens & Vollmer, 2010), only one study with one participant (Lalli & Casey, 1996) has involved evaluation of combined dimensions for social-negative reinforcement. Third, no studies have included within-subject evaluations of single and combined dimensions of reinforcement. Fourth, few studies have evaluated whether the reinforcement schedule under various manipulations could be thinned to increase maintenance and generalization of effects. Of the studies that have attempted to thin the schedule, several have been unsuccessful or showed EXT was required for successful thinning (DeLeon et al., 2011; Horner & Day, 1991; Piazza et al., 1997) and several others have shown successful schedule thinning to terminal schedules that

remained relatively dense (Hoch et al., 2002; Lalli et al., 1999; Lalli & Casey, 1996). Of the studies that did show effective thinning with some participants (Hoch et al., 2002; Lalli et al., 1999), the procedures were unclear, and for one study, it is possible the effects were due to an additional dimension that was manipulated during thinning (i.e., magnitude; Hoch et al., 2002) rather than the dimension that was the target of the study. Finally, an additional methodological limitation of the studies that evaluated the quality of negative reinforcement is that few of these studies involved systematic identification of the preferred attention or tangible items that were provided during breaks in studies evaluating the effects of enhanced break periods (e.g., Harding et al., 1999; Lalli & Casey, 1996; Piazza et al., 1997).

Purpose

The purpose of Study 1 was to replicate previous research on latency-based FAs to determine the function of problem behavior. As mentioned above, previous research has shown this method to be an efficient and potentially safer approach for determining the function of problem behavior because latency to the first occurrence of problem behavior is used rather than response repetition to indicate response strength. In addition, the results of the FA allowed us to identify individuals whose problem behavior was maintained by (a) social-negative reinforcement exclusively or (b) social-negative reinforcement and social-positive reinforcement for inclusion in the treatment evaluation in Study 2. The purpose of Study 2 was to replicate and extend previous research on DRA without EXT as an effective treatment for severe problem behavior maintained by social-negative reinforcement. First, we attempted to replicate and extend Athens and Vollmer (2010) and Hoch and colleagues (2002) by evaluating the influence of manipulating dimensions of reinforcement (i.e., magnitude and quality) in which the outcome for appropriate behavior (i.e., compliance) is better than the outcome for target problem

behavior. Second, we attempted to address limitations of previous research by (a) arranging the order of conditions within subject in an attempt to control for important potential history effects (i.e., history of DRA with EXT and history of social-positive reinforcement for the alternative response), (b) comparing the effects of magnitude and quality dimensions separately and in combination both within and across participants, and (c) systematically determining the positive reinforcers used in the quality dimension manipulation. Third, we attempted to extend previous research by determining whether intervention effects would maintain while the token exchange schedule for the alternative response was thinned. Specifically, we extended the research in this area by determining whether token reinforcers could be used to promote maintenance of treatment effects as the schedule of reinforcement was thinned.

Study 1 Method: Latency-Based Functional Analysis

Participants and Setting

Four individuals who were referred by their teachers and interventionists for the assessment and treatment of problem behavior (i.e., physical aggression, SIB) and whose problem behavior was hypothesized to be maintained by social-negative reinforcement participated in Study 1. The Human Research Protection Program at the University of Kansas approved this project, and informed consent was obtained by each participants' parent or guardian prior to participating in Study 1 and Study 2 of this experiment. All individuals had been previously diagnosed with an intellectual and developmental disability by a neurologist or psychologist as evidenced by their intake paperwork. In addition, all individuals were school aged and attended either a preschool, an early intervention program, or private school and received individualized behavioral services. Anna's expressive language was limited to several signs and she was able to follow simple, one-step instructions. Brock's expressive language was

limited to less than 10 picture exchange icons and he was able to follow simple, one-step instructions requiring moderate levels of prompting. Janice and Queenie could express themselves using 2-5 word sentences and they were capable of following complex, multi-step instructions. Table 1 shows detailed demographic information for each participant.

The therapist conducted FA sessions in either a small therapy room (3 m by 3 m) equipped with a one-way mirror (Anna), in a secluded area (1 m by 1 m) within the participant's classroom (Queenie), or in the participant's therapy room (5 m by 5 m; Janice and Brock). During all sessions, the area contained a table, two chairs, and condition-specific stimuli. The therapists conducted sessions 4 to 12 times per day, 2 to 5 days a week.

Materials

The session rooms contained padding on all walls, tables, doors, and the floor if the target severe problem behavior was object- or surface-directed SIB (Janice only). The therapists wore protective equipment such as arm sleeves, hats, gloves, long denim shirts, and arm guards if the target severe problem behavior was aggression. In addition, the therapist always had a blocking pad available to provide additional protection for the participant during instances of object- or surface-directed SIB or to protect themselves from aggression attempts. All FA sessions consisted of condition-specific stimuli (e.g., moderate- or high-preference items, instructional materials) that were informed by formal paired-stimulus preference assessments, caregiver interviews, and direct observations. In addition, therapists wore different colored t-shirts and placed different colored poster boards on the wall to aid in discrimination across conditions (Conners et al., 2000).

Response Measurement and Interobserver Agreement

Trained observers used handheld iPod Touch® devices to collect data on several participant and therapist behaviors. The primary dependent variable was latency to the first occurrence of the target problem behavior for each participant. Latency to target problem behavior was determined by taking the time in seconds (s) from the start of the session until the onset of the target behavior or until the end of a 5-min session (300 s), whichever came first. The operational definitions for each participant's problem behavior are in Table 2. Anna and Brock displayed aggression in the form of hitting and pushing. Janice displayed aggression in the form of hitting, kicking, biting, and scratching; and SIB in the form of body-to-object contact and hand-to-body contact. Queenie displayed aggression in the form of hitting, kicking, and pushing.

Trained observers collected data on several additional participant and therapist behaviors. Observers collected data on the frequency of therapist vocal-verbal only instructions (did not include instructions that included a model or physical prompt) and the frequency of participant compliance to instructions during the escape condition. Compliance was defined as correctly responding to the therapist's instruction within 5 s of a vocal or model prompt in the absence of target problem behavior and was converted to a percentage by dividing the frequency of compliance by the total number of therapist's vocal-verbal only instructions and multiplied it by 100%. For instance, if target problem behavior and compliance occurred at the same time, the observer would score the occurrence of the target problem behavior and would not count this as compliance. However, target problem behavior and compliance never occurred simultaneously during the latency-based FA for any participant. Additionally, observers collected data on the occurrence of (a) therapist removal of instructions during the escape condition, (b) therapist delivery of attention during the divided-attention condition, and (c) therapist delivery of tangible

item(s) during the tangible conditions. Latency to therapist removal and delivery of condition-specific consequences were determined by taking the time in seconds (s) from the start of the session until the onset of the therapist delivery or removal of condition-specific consequences or until the end of a 5-min session (300 s), whichever came first.

A second independent observer collected data on child and therapist behavior for an average of 48% (range, 34%-61%) of sessions across participants. The experimenters calculated interobserver agreement (IOA) for latency data on target problem behavior by dividing the shorter latency (in seconds) by the longer latency and multiplying it by 100%. Mean IOA for target problem behavior was 99.89% (range, 98%-100%) for Anna, 98.8% (range, 93%-100%) for Brock, 98.6% (range, 92%-100%) for Janice, and 99% (range, 99%-100%) for Queenie. We also calculated IOA for latency data on (a) removal of therapist instructions, (b) delivery of therapist attention (divided-attention condition only), and (c) therapist delivery of tangible items across all participants. Mean IOA for therapist delivery of consequences was 99.59% (range, 88%-100%) for Anna, 99% (range, 85%-100%) for Brock, 98.96% (range, 92%-100%) for Janice, and 99.67% (range, 98%-100%) for Queenie. Finally, the experimenters calculated IOA for frequency data (i.e., delivery of therapist instructions and compliance with therapist instructions) by dividing the session length into 10-s intervals and using the block-by-block proportional agreement method. We divided the smaller number of responses recorded by the larger number of responses within each interval and then summed the results, divided by the total number of intervals, and multiplied this number by 100%. Mean IOA was 93.95% (range, 67%-100%) for Anna, 97.45% (range, 77%-100%) for Brock, 96.65% (range, 42%-100%) for Janice, and 97.5% (range, 72%-100%) for Queenie.

Although the IOA percentages were high for mean agreement across measures, the ranges highlight that IOA percentages were low for some sessions for some participants. These low percentages reflect the fact that a small difference between observers' records for a very short latency represented a large proportional disagreement. For example, if a participant engaged in problem behavior within 33 s of the start of the escape test condition, the session would be terminated and block-by-block IOA data would be summed based on only these four, 10-s intervals. If there was a single disagreement within one of these intervals, it resulted in an average below desirable levels. For the sessions in which IOA percentages were below 80%, observers were retrained on the definitions of each behavior to ensure understanding and to minimize observer drift.

The experimenters calculated procedural integrity for FAs across participants for 32% of sessions. To determine procedural integrity, in a particular session, we evaluated whether the therapist (a) implemented the correct establishing operation (EO) throughout the entire session (e.g., presentation of demands in the escape condition, deprivation from attention in the attention condition), (b) provided the putative reinforcer within 3 s of the target problem behavior in relevant test conditions and did not provide programmed consequence in the no interaction or play conditions, (c) terminated the session contingent on target behavior within 5 s of the reinforcement interval during relevant test conditions and 1 min after the last instance of target problem behavior in the no interaction and play conditions, and (d) did not implement programmed consequences for any prosocial or nontargeted problem behavior during test and play conditions. If any of these four conditions was not met in a particular session, an integrity error was recorded for that condition. The experimenters calculated percentage of integrity for a particular session by dividing the number of the above conditions in a session scored as having

procedural integrity and dividing them by the number of conditions in a session scored as having procedural integrity plus those scored as having an integrity error and multiplying this number by 100%. Procedural integrity was calculated for an average of 32% of sessions (range, 30%-36%) across participants and averaged 96% (range, 75%-100%).

Pre-FA Procedures

Indirect assessment. Therapists conducted open-ended indirect assessments (see Appendix B; Hanley, 2012) and informal direct observations to determine each participants' target problem behavior. In addition, we used information gained about contexts and consequences to inform condition-specific variables in the FA, which included the types of demands presented in the escape condition, the type of attention delivered in the divided-attention condition, and potential leisure items and edible items included in preference assessments.

Preference assessment. Prior to conducting the FA, therapists conducted paired-stimulus preference assessments (PSPAs; Fisher et al., 1992) to determine items and activities to use in various conditions of the FA (Study 1) and subsequent treatment evaluation (Study 2). Therapists selected items for inclusion in the PSPAs based on results from the indirect assessment and other reports from caregivers. Therapists conducted leisure-item preference assessments with all participants, and the number of items included in the assessment ranged from 10-16 items across participants. Therapists also conducted edible preference assessments with participants who would and could consume edibles (Brock and Queenie), and the number of edibles included in the assessment ranged from 10-12 items. Therapists did not conduct an edible preference assessment with Anna or Janice because of dietary restrictions (Anna) or food refusal (Janice).

Prior to all PSPAs, the therapist provided pre-session access to each leisure item for approximately 30 s or to each edible until it was consumed. During all PSPAs, the therapist presented two stimuli on each trial and asked the participant to choose their favorite item. Once the participant chose one of the items (by saying the name of the item or touching the item), the therapist provided the participant access to the chosen item for 30 s (or until it was consumed). Therapists continued this process until all items in the assessment were presented with every other item once. If a participant did not choose an item on a particular trial, the therapist removed both items, and represented the items. If the participant still did not choose, the therapist scored that trial as "no choice," and presented the next trial.

The experimenters determined relative preference rankings for each assessment by summing the number of selections for each item, dividing this number by the total number of presentations of the item, and multiplying the quotient by 100%. High-preferred items from the leisure-item and edible-item (if applicable) PSPA outcomes were used during the latency-based FA in the play condition and the tangible (leisure item) and tangible (edible item) test conditions. Additionally, these items were selected for use during the quality manipulation evaluated in Study 2 (see Table 3 for a summary of items used within this condition). Moderate-preferred items from the leisure-item PSPA outcomes were used during the latency-based FA in the divided-attention condition. High preference items were those ranked as the top one or two and that were chosen on at least 75% of trials; moderate preference items were those ranked as the middle two or three and were chosen on approximately 40-50% of trials (except Janice).

Figure 1 depicts the results of the leisure-item PSPAs for all participants. As shown in the top left panel of Figure 1, Anna's high-preferred items were the squishy ball and Play Doh® (each selected on each selected on 91% of trials) and her moderate-preferred items were the

piano and bus (selected on 55% and 45 % of trials, respectively). As shown in the top right panel of Figure 1, Brock's high-preferred leisure items were the iPad® and baton (selected on 100% and 89% of trials, respectively) and moderate-preferred items were the puzzle and coloring (each selected on 44% of trials). As shown in the bottom left panel of Figure 1, Janice's high-preferred leisure item was her blanket (selected on 87% of trials) and moderate-preferred leisure items were the green squish and mix CD (selected on 7% of trials). Because Janice did not select any items on 40-50% of trials, we selected two items that she chose at least once in the PSPA to be moderate-preferred items. As shown in the bottom right panel of Figure 1, Queenie's high-preferred leisure items were the iPad® and tool box playset (each selected on 89% of trials) and her moderate-preferred items were the computer, purse, and Frozen book (each selected on 44% of trials).

Figure 2 depicts the results of the edible-item PSPAs for Brock and Queenie. As shown in the top panel, Brock's high-preference edibles were Snickers® and Cheez-Its® crackers (each selected on 78% of trials). As shown in the bottom panel of Figure 2, Queenie's high-preferred edibles were Cheetos® and Goldfish® crackers (each selected on 82% of trials).

Interobserver agreement (IOA) for PSPAs were conducted during 100% of PSPAs across participants. To calculate IOA during PSPAs, we used the trial-by-trial agreement method in which the number of trials with agreement on selection was divided by the number of trials with agreements and disagreements on selection and multiplying by 100%. Mean IOA was 100%.

Latency-Based Functional Analysis Procedure

Latency-based FA sessions were similar to those described by Thomason-Sassi et al. (2011). Trained graduate students conducted all sessions, which were a maximum duration of 5 min. FA conditions were conducted in the following fixed sequence and included (unless

otherwise specified) no-interaction, divided-attention, play, escape, tangible (leisure item), and tangible (edible item) conditions. However, because a recent summary of FA outcomes over the past 30 years reported a social function for aggression in 98% of FA cases, the experimenters omitted the no interaction test condition in FAs for aggression only as the target behavior (Beavers et al., 2013). Therefore, we omitted the no interaction test condition for Anna, Brock, and Queenie because the topography of their target problem behavior was aggression only; however, we included it for Janice because her target problem behaviors were both aggression and SIB. In addition, we omitted the tangible (edible) test condition in FAs for Anna and Janice because caregivers reported these participants could not or did not reliably consume edibles. Finally, because indirect assessments indicated that Janice's physical aggression and SIB were possibly maintained by social-negative reinforcement in the form of escape from therapist interactions, we included a social-avoidance condition to test this hypothesis.

During divided-attention, escape, and tangible conditions, the therapist provided the programmed consequence for the first occurrence of the target problem behavior and terminated the session. However, if the target problem behavior did not occur during the session, the therapist ended the session once the 5-min session had elapsed. During no-interaction and play conditions, the therapist terminated sessions 1 min after the occurrence of target problem behavior (to decrease the likelihood of intermittent social consequences for behavior). If the target problem behavior did not occur during the session, the therapist ended the session once the 5-min session had elapsed. If problem behavior was occurring at the end of a session, a 3-min calm criterion was instituted prior to the start of the next session in an attempt to control for carryover effects. If problem behavior was not occurring at the end of the session, then the next

session began once the therapist and observers had set up for the next session (typically less than 1 min).

Therapists put general and individualized procedural safeguards in place to protect themselves and their participants. In general, safeguards for the participants included (a) immediate treatment of injuries by onsite staff and (b) session-suspension criteria. That is, therapists and staff were trained to immediately treat injuries using first aid. In addition, had an injury occurred in which the therapists and staff did not have sufficient training to treat the (e.g., could not stop bleeding, the participant was showing signs of concussion), they were instructed to call 911 for emergency treatment. This never occurred. Further, if the participant engaged in 10 instances of head-directed SIB within 10 s or damaged protective equipment or the environment such that it was unsafe to continue conducting sessions, the therapist suspended further sessions until the environment was safe. Finally, if the participant did not de-escalate following a session for at least three min within a 10-min period, further sessions were suspended for the next two hours or the end of the day, whichever came first. During the latency-based FA for Anna (24 total sessions), Brock (25 total sessions), Janice (38 total sessions), and Queenie (18 total sessions) the session-suspension criteria was never met. For Janice, because she engaged in SIB, we put an additional procedural safeguard in place which involved pre- and post-session examinations to document bodily harm (i.e., SIT scale; see Appendix A; Iwata, Pace, Kissel, et al., 1990). For these, trained staff or the lead therapist conducted pre- and post-session examinations to document all marks on the participant's body such that new ones could be identified to receive immediate treatment. Fortunately, SIT scale examinations during the latency-based FA never revealed new or exacerbated injuries for Janice. A potential limitation is that a second, independent observer never conducted a SIT scale

examination concurrently and thus no IOA measures were calculated for this procedural safeguard.

Procedural safeguards for the therapist included (a) wearing protective equipment, (b) response blocking and evasion, and (c) eyes-on support from additional staff. The FA therapist wore protective equipment at all times which included arm sleeves and hats (all participants) and gloves, long denim sleeves, and arm guards (Janice and Brock). In addition, the FA therapist attempted to get out of the way of all instances of aggression and blocked instances with arm pads or blocking pads that were difficult to avoid. Finally, additional staff observed sessions to assist in blocking instances of severe problem behavior with arm pads or blocking pads if the problem behavior continued to escalate following the termination of the session. Fortunately, the severity of problem behavior never escalated to meet termination criteria during the latency-based FA.

No interaction. The purpose of this condition was to determine if problem behavior maintained in the absence of social consequences (i.e., automatic reinforcement). During these sessions, the therapist wore a black t-shirt and a black poster board was placed on the wall in the room. Prior to the start of the session, the therapist told the participant, “This is the black condition. I can’t talk to you.” During this session, the environment was barren (i.e., no toys or additional stimuli are present) and no programmed consequences were delivered for any instance of participant behavior. In addition, the therapist was positioned in front of any exits to anticipate blocking any instances of elopement with minimal attention and was turned away from the participant (either seated or standing) to avoid any eye contact.

Divided attention. The purpose of this condition was to determine if problem behavior was maintained by social-positive reinforcement in the form of attention. Sessions were similar

to those described by Fahmie and colleagues (2013) in which the antecedent event consisted of the therapist conversing with an adult confederate. In the current study, the divided-attention condition was favored over the typical attention condition because it (a) closely resembled antecedent conditions in the target participants' every day environment, (b) might be a more effective discriminative stimulus or EO for attention-maintained behavior, and (c) has been shown to be a viable alternative to the typical attention condition (Fahmie et al., 2013). During all sessions, the therapist entered the room with an adult confederate and both the therapist and adult confederate wore a blue t-shirt and a blue poster board was placed on the wall in the room. Prior to the start of the session, the therapist told the participant, "This is the blue condition. I'm busy talking with (confederate's name), so here are some things you can play with." During the session, moderately preferred leisure items (as determined by the paired stimulus preference assessment [Fisher et al., 1992]) were present and the therapist ignored the participant and engaged in continuous conversation with the confederate. However, if the participant engaged in the target problem behavior, the therapist stopped conversing with the confederate and provided a brief period of physical and vocal-verbal attention (as determined by the indirect assessment and direct observation results). Physical and vocal-verbal attention consisted of providing a reprimand (for example, "Stop that! That hurts!") while placing a hand on the participant's arm (for Anna, Brock, and Queenie) or consoling and comforting the participant (for example, "Don't do that, you're going to hurt yourself.") while placing a hand on the targeted area and rubbing or rubbing the participant's back (for Janice).

Social avoidance (Janice only). The purpose of this condition was to determine if problem behavior was maintained by social-negative reinforcement in the form of avoidance of social interactions. During these sessions, the therapist wore a yellow t-shirt and a yellow poster

board was placed on the wall in the room. Prior to the session, the therapist told the participant, "This is the yellow condition. I'm going to sit here and talk with you." During the session, the therapist provided continuous vocal interaction by describing things in the immediate environment and delivering physical interaction approximately every 30 s. However, contingent upon the occurrence of the target problem behavior, the therapist discontinued social interaction and turned away from the participant for 30 s.

Escape. The purpose of this condition was to determine if problem behavior was maintained by social-negative reinforcement in the form of escape from demands. During these sessions, the therapist wore a red t-shirt and a red poster board was placed on the wall in the room. Prior to the session, the therapist told the participant, "This is the red condition. It's time to work." During the session, the therapist continuously presented difficult or non-preferred tasks (as determined by interviews with caregivers and informal direct observations) to the participant using a three-step prompting procedure (vocal-verbal instruction, vocal-verbal instruction plus model prompt, vocal-verbal instruction plus physical prompt). Demands were similar to those used in each participants learning environment and represented a range of skills, including academic (e.g., sight words and instruction following), daily living (e.g., sorting clothing items), and domestic (e.g., cleaning up) tasks, approximately half of which required physical movement (e.g., standing up or bending over to pick up). However, contingent upon the occurrence of the target problem behavior, the therapist removed the materials associated with the task and turned away from the participant for 30 s.

Tangible (leisure item). The purpose of this condition was to determine if problem behavior was maintained by social-positive reinforcement in the form of access to leisure items. During these sessions, the therapist wore a green t-shirt and a green poster board was placed on

the wall in the room. Prior to the session, the therapist provided the participant with highly preferred leisure items (the top two as determined by a paired-stimulus preference assessment [Fisher et al., 1992]) for 2 min. After 2 min of access, the therapist removed the highly preferred items and told the participant, "This is the green condition. It's my turn." However, contingent on the occurrence of the target problem behavior, the therapist immediately provided the participant with 30-s access to the item(s).

Tangible (edible item; Brock and Queenie only). The purpose of this condition was to determine if problem behavior was maintained by social-positive reinforcement in the form of access to edible items. During these sessions, the therapist wore a yellow t-shirt and a yellow poster board was placed on the wall in the room. Prior to the session, the therapist provided access to the highly preferred edible items (the top two edibles as determined by a paired-stimulus preference assessment [Fisher et al., 1992]) to the participant until consumed. Following the consumption of 3-5 small edibles, the therapist removed access to the highly preferred edibles and told the participant, "This is the yellow condition. It's my turn." However, contingent on the occurrence of the target problem behavior, the therapist immediately provided the participant with 30-s access to the edibles.

Play. The purpose of this condition was to serve as the control condition. During these sessions, the therapist wore a white t-shirt and a white poster board was placed on the wall in the room. Prior to the start of the session, the therapist told the participant, "This is the white condition. We get to play with your favorite things and you can have some of your favorite snacks!" During the session, highly preferred leisure and edible items (if applicable) used in the tangible conditions were continuously made available and the therapist provided continuous interaction throughout the session. The therapist did not place any demands on the participant.

Experimental Design

The experimenters used a multielement design to evaluate the effects of the various test and control conditions on target problem behavior. To identify the function of target problem behavior, we determined which test condition(s) showed consistently shorter latencies to the target problem behavior when compared to the control condition.

Study 1 Results and Discussion: Latency-Based Functional Analysis

Figures 3-6 depict the results of the latency-based FA for all participants. Anna's FA data are depicted in Figure 3 and show that there was a consistently shorter latency to physical aggression in the escape condition (*M* = 124.9 s; range, 61 s-150 s) as compared to the control condition (*M* = 300 s) suggesting that Anna's physical aggression was maintained by escape from demands.

Brock's FA data are depicted in Figure 4, and results show that there was a consistently shorter latency to physical aggression in the escape condition (*M* = 160.2 s; range, 6 s-300 s), divided-attention condition (*M* = 182.9 s; range, 13 s-121 s), tangible (leisure-item) condition (*M* = 67.6 s; range, 19 s-128 s), and tangible (edible-item) condition (*M* = 131.2 s, range: 42 s-254 s) as compared to the control condition (*M* = 268.4 s; range, 79 s-300 s). These data suggest that Brock's physical aggression was maintained by all social reinforcers including, escape from demands, access to attention, access to leisure items, and access to edible items. Unfortunately, interpretation of Brock's FA data is limited because the pattern of responding (problem behavior high in all test conditions and low in the control) also resembles a common pattern for problem behavior maintained by automatic reinforcement. Typically, researchers and clinicians should attempt to clarify the results of unclear outcomes prior to moving forward with treatment; however, given the topography of the problem behavior (i.e., physical aggression) and because

he is a student with communication deficits, the identification of multiple social functions was plausible and an automatic function was unlikely. Future researchers should still consider conducting further analyses to clarify results, which may include conducting a test-control pairwise evaluation to determine whether it was a failure to discriminate across conditions, maintained by automatic reinforcement, or multiply maintained.

Janice's FA data are depicted in Figure 5 and show that there was a consistently shorter latency to physical aggression and SIB in the escape condition (*M* = 141.2 s; range, 31 s-300 s) as compared to the control condition (*M* = 300 s) suggesting that Janice's physical aggression and SIB were maintained by escape from demands. In addition, because results of the initial FA did not rule out a possible social-positive function in the form of access to tangible leisure items, her therapist conducted a test-control pairwise evaluation of the tangible (leisure-item) test condition as compared to a control condition to determine whether her problem behavior occurred as a function of this variable. Results of this latter analysis demonstrated that her problem behavior was not maintained by access to tangible (leisure) items.

Queenie's FA data are depicted in Figure 6 and show that there was a consistently shorter latency to physical aggression in the escape condition (*M* = 132.5 s; range, 20 s-300 s) as compared to the control condition (*M* = 300 s) suggesting that Queenie's physical aggression was maintained by escape from demands.

Overall, results for these four participants indicate that target problem behavior is exclusively maintained by social-negative reinforcement (i.e., escape from instructional demands) for Anna, Janice, and Queenie and by social-negative reinforcement and social-positive reinforcement in the form of access to attention, leisure items, and edible items for Brock.

Table 4 depicts total assessment duration and total number of responses for participants during the latency-based FAs and compares these outcomes to derived total assessment duration and total number of responses if these participants had undergone a standard FA. The experimenters determined derived "total duration" for the standard FA by counting the number of sessions the participant experienced in the latency-based FA and multiplying it by 5 min. We derived "total number of responses" for the standard FA by calculating the potential rate per session given the latency in which PB occurred, multiplying the rate by 5 min, and adding these totals across conditions for each participant. For instance, results of the latency-based FA show Anna's assessment was completed in 12 sessions (total of 46.45 min spent in assessment) in which four instances of target problem behavior occurred as compared to the derived potential duration of 60 min in which 15 instances might have occurred. Brock's assessment was completed in 25 sessions (total of 54.76 min spent in assessment) in which 20 instances of target problem behavior occurred as compared to the derived potential duration of 125 min in which 57 instances might have occurred. Janice's assessment was completed in 38 sessions (total of 161.13 min spent in assessment) in which nine instances of target problem behavior occurred as compared to the derived potential duration of 190 min in which 45 instances might have occurred. Queenie's assessment was completed in 18 sessions (total of 78.83 min spent in assessment) in which three instances of target problem behavior occurred as compared to the derived potential duration of 90 min in which 21 instances of might have occurred. Thus, these data suggest the possibility of determining clear functions relatively quickly and with potentially fewer instances of target problem behavior when compared to derived outcomes if these test conditions had been conducted for the full 5 min as is typically the method in standard FAs. However, it should be made clear that these comparisons should be interpreted cautiously

because they are based on derived measures and are not direct measures of quantitative data. Therefore, in order to determine relative efficiency and safety, future researchers should continue to expand upon this line of research by replicating procedures similar to Thomason-Sassi and colleagues (2011) where the results of initial latency-based FAs are directly compared to the results of subsequent full-FAs so that relative efficiency, accuracy, and safety can be compared. Overall, latency-based FAs might represent a potentially more efficient, and potentially safer, method for determining the function of severe problem behavior.

Further measures suggesting the potential safety of latency-based FAs are in Table 5, which shows the use of procedural safeguards and injuries sustained during FAs. These data were gathered from session data summaries, SIT scales, and incident reports to determine if (a) target problem behavior met termination criteria or session suspension criteria, (b) injuries from SIB were identified during pre- and post-session SIT checks, and (c) incident reports were filed for instances in which first aid was implemented for either the participant or therapist. With the exception of one incident in which the therapist needed to wash with soap and bandage the back of his right ear due to a scratch received within the context of the latency-based FA with Janice, there were no records indicating that any of these procedural safeguards or injuries occurred. Although these are safety indicators which relied on the within-session therapist following criteria for terminating, suspending, recording, or reporting information, they still suggest the potential safety of this assessment approach.

Study 2 Method: DRA (Compliance) without EXT for Problem Behavior Maintained by Social-Negative Reinforcement

Participants and Setting

All four participants from Study 1 (i.e., Anna, Brock, Janice, and Queenie) whose problem behavior was demonstrated to be maintained by social-negative reinforcement (i.e., escape from instructions) only or social-negative reinforcement and social-positive reinforcement (i.e., access to attention or tangible items) participated in Study 2. Therapists conducted all sessions during Study 2 in the same setting as in Study 1. Further, these four participants had no record that a token economy had been used in previous programming.

Materials

Therapists used protective equipment for participants and therapists as described in Study 1. During the attention assessment, therapists presented seven photos, each denoting a different type of attention and a blank, solid white control card. Each photo was affixed to a different color card to aid in discrimination. During the token assessment, the task involved a simple operant response which required a blank, white card. Additionally, tokens and a token board were used during token assessment and some DRA without EXT sessions. Tokens were laminated square pieces of white poster board with VELCRO® backing. The token board included VELCRO® spots for tokens. All DRA without EXT sessions included the instructional materials present during the escape condition of the FA for a particular participant.

Response Measurement and Interobserver Agreement

As in Study 1, trained observers used handheld iPod Touch® devices to collect data on several participant and therapist behaviors. The primary dependent variables were the participant's (a) rate of the target problem behavior and (b) percentage of compliance with instructional demands in the absence of target problem behavior. Definitions for these dependent variables were identical to those described in Study 1. Experimenters converted data collected

using a frequency measure into a rate measure by taking the frequency of the target problem behavior and dividing it by the duration of the session.

In addition, observers used event recording to score the frequency of therapist instructions and the frequency of participant compliance. Data were converted to a percentage of compliance measure the same way as in Study 1. Observers also used event recording to score the frequency of therapist delivered tokens for participant compliance. Observers used duration recording to score therapist (a) removal of instructional demands, (b) delivery of attention, and (c) delivery of tangible items during each session. The observers collected duration data for each instance by scoring the onset and offset of these stimuli.

A second independent observer collected data on participant and therapist behavior for an average of 32.3% (range, 27.8%-35%) of sessions across participants. For behavior scored using a frequency measure (i.e., discrete instances of target problem behavior, delivery of therapist instructions, participant compliance with therapist instructions, and therapist delivery of tokens), IOA was calculated by dividing the session into 10-s intervals and using the block-by-block agreement method as in Study 1. Mean IOA was 98.6% (range, 92%-100%) for Anna, 97.9% (range, 96%-100%), for Brock, 97.88% (range, 95.8%-100%) for Janice, and 95.44% (range, 83%-100%) for Queenie. For behavior scored using duration recording (i.e., removal of therapist instructional demands, delivery of therapist attention, and therapist delivery of tangible items), IOA was calculated for each duration scored by taking the smaller duration divided by the larger duration, summing these proportions, and multiplying this number by 100%. IOA was 99.3% (range, 95%-100%) for Anna, 98.8% (range, 77%-100%) for Brock, 99% (range, 93%-100%) for Janice, and 97.8% (range, 87%-100%) for Queenie.

Experimenters calculated procedural integrity for the DRA without EXT evaluation across participants for 40% of sessions. To determine procedural integrity, in a particular session, we evaluated whether the therapist (a) presented instructional demands using a three-step prompting procedure (vocal-verbal instruction, vocal-verbal instruction plus model prompt, vocal-verbal instruction plus physical prompt), (b) provided the condition-specific consequence contingent on compliance when it occurred (i.e., praise, break, preferred attention, preferred leisure items, preferred edible items, and tokens), (c) provided the condition-specific consequence contingent on target problem behavior when it occurred (i.e., 30-s break or EXT during baseline), (d) omitted programmed consequences for any prosocial or nontargeted problem behaviors when it occurred, and (e) adhered to the correct schedule of reinforcement (e.g., FR 1, FR 2, FR 4) during schedule thinning. If any of these five conditions was not met in a particular session, an integrity error was recorded for that condition. We calculated percentage of integrity for a particular session by dividing the number of the above conditions in a session scored as having procedural integrity and dividing them by the number of conditions in a session scored as having procedural integrity plus those scored as having an integrity error and multiplying this number by 100%. Procedural integrity was calculated for an average of 40% of sessions (range, 33%-60%) across participants and averaged 94% (range, 80%-100%).

Pre-Treatment Assessment

Therapists conducted two pre-treatment assessments prior to the DRA without EXT evaluation. First, they conducted a pictorial paired-stimulus preference assessment (Faw, Davis, & Peck, 1996; Northup, George, Jones, Broussard, & Vollmer, 1996) to determine the most preferred type(s) of attention for each participant. Therapists provided access to one or more types of high-preferred attention (i.e., attention chosen at least 80% of trials) during various

phases of the DRA without EXT evaluation. Second, therapists conducted a token assessment to determine whether tokens were neutral stimuli for each participant. Therapists used tokens during DRA without EXT phases during schedule thinning. Therapists who conducted the DRA without EXT treatment evaluation also conducted the attention assessment and token assessment for that particular participant.

Attention assessment. Procedures for the attention assessment were similar to those described by Kelly, Roscoe, Hanley, and Schlichenmeyer (2014). Seven topographies of attention were included in the stimulus array for the pictorial paired-stimulus preference assessment. For all participants, therapists included four common types of attention including tickles, head rubs, praise, and conversation because these forms of attention have been reported to function as common reinforcers in previous research (e.g., Harper, Dozier, Brandt, & Briggs, 2014; Piazza et al., 1999; Smaby, MacDonald, Ahearn, & Dube, 2007). The therapist selected the remaining three types for inclusion based on information gathered from a social-stimuli questionnaire (see Appendix C; Kelly et al., 2014), which two caregivers for each participant completed. These three types of attention are those that were (a) other types of attention than the four common types that were already included, (b) positive interactions (interactions such as reprimands and restraint were not used), and (c) ranked highest in the questionnaire.

Prior to the start of the assessment, the therapist created photos that corresponded with the seven types of attention. Definitions for the types of attention evaluated across participants are depicted in Table 6. Each photo depicted the therapist delivering a single type of attention to the participant. Before the start of the session, the therapist conducted exposure trials with each photo. That is, the therapist used three-step prompting to have the participant touch each photo and experienced 5 s access to the type of attention depicted in the photo. Next, the therapist

presented the photos and a white control card in pairs with both position and pairings counterbalanced across trials (see Appendix D for an example of this arrangement). Contingent on photo selections, the therapist removed the non-selected photo and delivered the selected type of attention for approximately 5 s. If the control card was selected, the therapist looked down and provided no attention for 5 s. The therapist blocked attempts to approach both photos (or control card) simultaneously. If the participant did not select a photo (or control card) within 5 s, the therapist represented them. If the participant still did not select either photo (or control card) within 5 s of re-presentation, the therapist removed both photos (or control card) and initiated the next trial. To determine the most preferred types of attention, trained observers recorded the participants' photo and control card selections (defined as touching, pointing, or vocalizing) during each trial. Experimenters determined relative preference rankings by summing the number of selections for each type of attention and control card, dividing this number by the total number of presentations of the stimulus, and multiplying the quotient by 100%.

The type(s) of attention chosen for at least 80% of trials were used during the "enhanced" conditions of the DRA without EXT evaluation (see Table 3 for a summary of items used within this condition). If a type of attention was not selected for at least 80% of trials, the therapist determined the top 2-4 types of attention and either (a) re-conducted the pictorial paired-stimulus preference assessment with just those picture cards (Anna) or (b) conducted a concurrent-operants reinforcer assessment to determine response allocation to each of the picture cards (Janice and Queenie). Prior to reinforcer assessment sessions, the therapist instructed the participant to touch each picture card and control card and delivered the corresponding stimulus. Reinforcer assessment sessions were 2 min in duration and picture touches resulted in the therapist providing the type of attention depicted on each picture card. Rate of picture touches

was calculated and the top types of attention were used during the “enhanced” conditions of the DRA without EXT evaluation (see Table 3 for a summary of items used within this condition).

A second observer collected data on participant selections and response allocation during the attention assessment and reinforcer assessment, respectively for 100% of sessions across participants. For the attention assessment, observers’ used the trial-by-trial agreement method in which the number of trials with agreement on selection were divided by the number of trials with agreements and disagreements on selection and multiplied by 100%. Mean IOA was 99% (98%-100%). For the reinforcer assessment, observers’ divided the session into 10-s intervals and used the block-by-block agreement method to calculate IOA. To do so, the smaller number of responses recorded were divided by the larger number of responses in each interval, summed, divided by the total number of intervals, and multiplied by 100%. Mean IOA for Janice was 98.6% (range, 97%-100%) and for Queenie was 100%.

Figure 7 depicts the results of the initial attention assessment for all four participants. Anna’s top preferred type of attention was facial expressions (selected on 71% of trials). Brock’s top preferred type of attention was facial expressions (selected on 86% of trials). Janice’s top preferred types of attention were praise and conversation (selected on 64% and 57% of trials, respectively). Queenie’s top preferred types of attention were high fives, hugs, and conversation (each selected at 64% of trials). However, because Anna, Janice, and Queenie did not display strong preferences for any types of attention (i.e., selection on 80% or more trials), we conducted additional analyses with them.

For Anna, the top four types of attention (facial expressions, praise, hugging, and conversation) from the initial attention-assessment were used along with the control card to conduct a second attention assessment. Results of the second attention assessment are depicted

in Figure 8 and show that Anna preferred hugging (selected on 100% of trials) over the other types of attention and the control card.

For Janice and Queenie, the top two types of attention (praise and conversation) for Janice and top three types of attention (high fives, hugs, and conversation) for Queenie from the attention assessment were included in a reinforcer assessment along with a control card. Figure 9 depicts the results of the reinforcer assessment for Janice and Queenie. Results indicate that Janice consistently responded at higher mean rates for conversation (*M* = 2 RPM; range, 0-4 RPM) as compared to praise (*M* = 0.1 RPM; range, 0-0.5 RPM) and control (*M* = 0.1 RPM; range, 0-0.5 RPM). Similarly, results indicate that Queenie consistently responded at higher mean rates for conversation (*M* = 0.5 RPM; range, 0-1 RPM) as compared to high fives (*M* = 0.25 RPM; range, 0-1 RPM), hugs (*M* = 0.08 RPM; range, 0-0.5 RPM), and control (*M* = 0 RPM). Therefore, these types of attention were used during DRA without EXT sessions in which enhanced breaks were provided for compliance (see Table 3 for a summary of items used within this condition).

Token assessment. All token assessment sessions were 2 min in duration and conducted by the therapist expected to implement the DRA without EXT evaluation. The target response was a simple operant response (i.e., touching a blank card). In addition, a moderately preferred alternate activity (as determined by the stimulus preference assessment in Study 1) was concurrently available during all sessions (see Appendix E for an example of this arrangement). This activity was available to provide the participant with something to do other than the target task. Prior to the start of each session, the therapist conducted two pre-session prompts for the participant to engage in the target response and access the programmed consequences for that particular session. Conditions included baseline and token sessions, and we used a reversal

design for experimental control. During both conditions, the therapist delivered noncontingent praise for appropriate attending behavior (e.g., sitting nicely) once every 30 s throughout each session. During baseline sessions, the therapist did not deliver any consequences for engaging in the target response. During token sessions, the therapist delivered a token by placing it on an open spot on a token board that was similar to the one used in the DRA without EXT schedule thinning condition (see Appendix F for an example of this arrangement). At the end of token sessions, the therapist removed the tokens from the token board. No backup reinforcers were available for token exchange during this assessment. The dependent variable during the token assessment was the rate of the target response. Trained observers recorded the frequency of target responses and divided the frequency by the session duration to determine the rate of responding. A second independent observer collected data for an average of 30.6% (range, 26%-33%) of sessions across participants. Observers' divided the session into 10-s intervals and used the block-by-block agreement method to calculate IOA. To do so, the smaller number of responses recorded were divided by the larger number of responses in each interval, summed, divided by the total number of intervals, and multiplied by 100%. Mean IOA was 100% for Anna, Brock, and Queenie and 99.6% (range, 97.9%-100%) for Janice.

Figure 10 depicts the results of the token assessment for all participants. As shown in the top left panel of Figure 10, Anna engaged in low levels of responding across conditions. In fact, her baseline rate (*M* = 0.33 RPM; range, 0-1 RPM) was slightly higher as compared to the rate when tokens were present (mean 0.08 RPM; range, 0-0.5 RPM). As shown in the top right panel of Figure 10, Brock engaged in zero rates of responding during both the baseline and token phases. As shown in the bottom left panel of Figure 10, Janice engaged in zero rates of responding in baseline and variable but overall low levels of responding in the token phase (*M* =

1.8 RPM; range, 0-17.5 RPM). As shown in the bottom right panel of Figure 10, Queenie engaged in zero rates of responding during both the baseline and token phases. Overall, these response patterns suggest that tokens did not function as reinforcers for the participants.

DRA without EXT Evaluation

To determine the conditions under which DRA without EXT is effective, the experimenters manipulated single dimensions of reinforcement (i.e., magnitude and quality) and a combination of these dimensions of reinforcement for compliance while problem behavior continued to result in reinforcement. To evaluate the influence of single dimensions of reinforcement, we compared (a) a 30-s break versus a 2-min break for compliance (magnitude evaluation) and (b) a 30-s break without preferred attention and tangibles versus a 30-s break with preferred attention and tangibles for compliance (quality evaluation) while the target problem behavior continued to result in a 30-s break. To evaluate the influence of a combination of these dimensions of reinforcement, we evaluated the effects of a 2-min break with preferred attention and tangibles for compliance (magnitude and quality evaluation) while the target problem behavior continued to result in a 30-s break. To determine whether intervention effects maintained while thinning the token exchange schedule for compliance, we delivered tokens on an FR 1 schedule for compliance while attempting to systematically increase the number of tokens needed to access the programmed reinforcer (from an FR 1 to an FR 20). We conducted schedule thinning under the conditions in which DRA without EXT was found to be effective.

Initially, DRA without EXT evaluation sessions were 5-min in duration for Janice and Brock; however, once an effective treatment condition was identified sessions increased to 10 min in duration. At this point, we decided to continue with 10 min sessions for the remainder of the study in an attempt to examine whether the presence or absence of effects could be observed

more quickly. For Anna and Queenie, all DRA without EXT evaluation sessions were 10 min in duration. During all sessions, the therapist presented similar instructional demands that they presented in the escape condition of the FA for each participant. The therapist presented demands continuously throughout the session using a three-step prompting procedure (vocal-verbal, model, and physical prompt hierarchy). However, during all sessions, each occurrence of target problem behavior resulted in a 30-s break in which the therapist removed demand materials and turned away from the participant for the duration of the break. Breaks were also provided for compliance during some sessions. That is, after a participant complied with a demand following the therapist's vocal-verbal instruction or model prompt in the absence of target problem behavior, the therapist removed the demand materials and did not deliver instructions for a predetermined period of time. However, after any break, the therapist resumed presenting demands using the three-step prompting procedure. If the participant engaged in the target problem behavior and compliance simultaneously, the therapist would have delivered the contingencies for the target problem behavior (i.e., 30-s break). However, target problem behavior and compliance never occurred simultaneously during the DRA without EXT evaluation for any participant.

First, the experimenters evaluated the effects of DRA without EXT in which the reinforcer for problem behavior and compliance was equated (30-s break; *DRA without EXT [equated consequences]*). If this procedure was effective, we implemented schedule thinning. If this procedure was ineffective or treatment effects were lost during schedule thinning, we moved to the next DRA without EXT phase of the study. This next phase was DRA without EXT in which the reinforcer for compliance was higher in magnitude (2-min break) than the reinforcer for problem behavior (30-s break; *DRA without EXT [un-equated consequences]*). If this

procedure was ineffective, we moved to the next DRA without EXT phase of the study. The next phase was DRA without EXT in which the reinforcer for compliance was higher in quality (30-s break with access to preferred items [leisure and edible items] and attention) than the reinforcer for problem behavior (30-s break only; *DRA without EXT [enhanced, equated consequences])*. In these sessions, the attention was the high-preferred form(s) of attention from the attention assessment or reinforcer assessment, the top one (Janice) or two (Anna, Brock, and Queenie) preferred leisure items as determined by the leisure item preference assessment in Study 1, and the participant's choice of one of the top two edibles (as determined by the paired stimulus preference assessment conducted in Study 1; Brock only). If this procedure was effective, we implemented schedule thinning. If this procedure was ineffective or treatment effects were lost during schedule thinning, we moved to the next DRA without EXT phase of the study. The next phase was DRA without EXT in which the reinforcer for compliance was both higher in magnitude and higher in quality (2-min break with access to preferred items and attention during the break) than the reinforcer for problem behavior (30-s break; *DRA without EXT [enhanced, un-equated consequences (2 min)]*). If this procedure was effective, then we implemented schedule thinning. If this procedure was ineffective or treatment effects were lost during schedule thinning, we moved to the next DRA without EXT phase of the study. The next phase was DRA without EXT in which the reinforcer for compliance was increasingly higher in magnitude, resulting in longer access to the high-quality items (4-min break with access to preferred items and attention during the break) than the reinforcer for problem behavior (30-s break; *DRA without EXT [enhanced, un-equated consequences (4 min)]*). This latter condition was only implemented with Janice. If this procedure was effective, then we implemented

schedule thinning (see Table 7 for a summary of DRA without EXT contingencies for problem behavior and compliance across conditions).

Baseline. During baseline sessions, the therapist delivered praise for each instance of compliance and a 30-s break for each instance of target problem behavior. This condition was only implemented as a control condition for the DRA without EXT (equated consequences) condition when effects were found under this condition.

DRA without EXT (equated consequences). During this condition, the therapist delivered a 30-s break for each instance of compliance and the target problem behavior.

DRA without EXT (un-equated consequences). During this condition, the therapist delivered a 2-min break for each instance of compliance and a 30-s break for each instance of target problem behavior.

DRA without EXT (enhanced, equated consequences). During this condition, the therapist delivered an enhanced or "high-quality" 30-s break for each instance of compliance and a 30-s break only for each instance of target problem behavior. The enhanced break included continuous access to high-preferred therapist attention (as determined by the attention assessment), the top one (Janice) or two (Anna, Brock, and Queenie) preferred leisure items as determined by the leisure item preference assessment in Study 1, and a choice between the top two preferred edible items (Brock only) as determined by the edible preference assessment conducted in Study 1 (see Table 3 for a summary of these preferred items for each participant). The therapist included multiple types of preferred positive reinforcers to decrease the likelihood of satiation to these stimuli (Egel, 1980, 1981; North & Iwata, 2005).

DRA without EXT (enhanced, un-equated consequences [2 min]). During this condition, the therapist delivered a high magnitude and enhanced break for each instance of

compliance, which included a 2-min break with access to all of the stimuli provided in the DRA without EXT (enhanced, equated consequences) condition. The therapist continued to deliver a 30-s break for each instance of target problem behavior.

DRA without EXT (enhanced, un-equated consequences [4 min]). During this condition, procedures were identical to the enhanced, un-equated procedures described above; however, the duration of the break was 4 min. This condition was only conducted with one participant (Janice).

DRA without EXT Schedule Thinning

The purpose of schedule thinning was to determine whether effective DRA without EXT procedures resulted in maintained treatment effects even as the schedule of reinforcement for compliance was thinned. Therefore, the therapist implemented conditions as described above when treatment effects were observed under a treatment condition; however, tokens were introduced and delivered on an FR 1 schedule for compliance. During all schedule-thinning sessions, the therapist continued to deliver tokens on an FR 1 schedule for compliance and a 30-s break for each instance of target problem behavior; however, the token exchange rate to access the programmed reinforcer for compliance was systematically increased across sessions. For example, if schedule thinning was implemented under the DRA without EXT (equated consequences) condition, the therapist continued to deliver tokens for each instance of compliance and a 30-s break for target problem behavior; however, across sessions, the number of tokens required to exchange for a 30-s break for compliance was systematically increased.

The token exchange rate was systematically increased from an FR 1 to an FR 2 and then increased by two until the terminal goal of an FR 20 exchange rate was reached, or until a schedule was reached in which consistent maintained effects were observed. The token board

included the number of VELCRO® spots and tokens of the terminal response requirement (i.e., 20 tokens) for each session, but was missing the precise number of tokens of the current response requirement to help signal to the participant the number of tokens required to fill the board and access the programmed reinforcer. For example, if the exchange rate was an FR 4, then the token board was missing four tokens. Increases in the response requirement for token exchanges occurred after two consecutive sessions in which problem behavior maintained at a 90% reduction from the DRA without EXT condition serving as the baseline comparison (typically this was the equated-consequences condition). However, if this criterion was not met, and target problem behavior occurred above this criterion for two consecutive sessions, the previous schedule under which the criteria was met was implemented and systematic thinning continued. As mentioned above, if this procedure was ineffective or the efficacy decreased with reinforcer thinning, and thus the criterion failed to be met after two attempts at a given schedule, the participant moved to the next DRA without EXT phase of the treatment evaluation. Throughout the schedule-thinning phase, brief probes of the terminal response requirement (i.e., FR 20) were conducted immediately following every third thinning step in which criteria was met (e.g., following success at FR 4 and FR 10 exchange schedules). The purpose of these probes was to determine whether tokens would maintain responding without further schedule thinning.

Prior to the beginning of each schedule-thinning and brief-probe session, the therapist stated the criterion for earning the programmed reinforcer. For example, prior to schedule-thinning sessions in which the token exchange was FR 4 during DRA without EXT (equated consequences) sessions, the therapist said, “When you get four tokens by doing what I ask you to do, you can have a short break.” During all schedule-thinning and brief-probe sessions, each time the token exchange rate was met, the therapist provided praise and told the participant they

earned the programmed reinforcer. For example, during DRA without EXT (un-equated consequences) sessions in which the token exchange rate was FR 4, the therapist told the participant, "Great! You earned four tokens. You get your break." Next, the therapist delivered the programmed reinforcer for this condition. The therapist then removed the token(s) from the token board and placed these materials back in front of the participant following the conclusion of the reinforcement period and prior to the start of a new instructional period. A potential limitation of our token economy for schedule thinning is that we did not conduct a systematic token training in which specifically trained participants on each component of the token schedule (e.g., token earning, token exchange) prior to introducing the tokens. Rather, we simply introduced them in the replication of a previously effective condition. Thus, future researchers should determine whether systematic token training would enhance the maintained efficacy of treatment effects.

Experimental Design

We used a reversal design to evaluate the effects of the DRA without EXT evaluation. Specifically, if we demonstrated an effect with a particular condition, then we used a previous ineffective condition as the control condition by which to replicate the effects. For example, if the DRA without EXT (equated consequences) condition was effective, then we compared the effects of this condition to those of a baseline condition. However, if the DRA without EXT (enhanced, equated consequences) condition was effective, then we compared the effects of this condition to those of DRA without EXT (equated consequences) condition. For Janice, in which the DRA without EXT (enhanced, un-equated [4 min]) condition was effective, we compared the effects of this condition to those of DRA without EXT (enhanced, equated) condition.

Study 2 Results and Discussion: DRA (Compliance) without EXT for Problem Behavior Maintained by Social-Negative Reinforcement

Figures 11-14 depict the results of the DRA without EXT evaluation for all participants. Results for Anna are depicted in Figure 11. During the initial equated consequences condition, Anna engaged in low levels of physical aggression and moderate levels of compliance when both physical aggression and compliance resulted in a 30-s break on an FR 1 schedule. Next, Anna experienced the baseline condition in which physical aggression continued to result in a 30-s break; however, compliance only resulted in praise. Anna engaged in high levels of physical aggression and moderate levels of compliance in this condition. Next, the therapist returned to the equated consequences condition; however, Anna's rate of physical aggression maintained at baseline levels and compliance decreased throughout the phase. These data suggest that 30-s breaks for compliance might initially maintain responding when delivered on a dense schedule; however, once Anna contacted reinforcement for physical aggression in baseline, she continued to engage in this response rather than compliance to access the 30-s break. Therefore, Anna's therapist implemented the un-equated condition in which physical aggression continued to result in a 30-s break; however, compliance now resulted in a 2-min break on an FR 1 schedule of reinforcement. In this phase, Anna continued to engage in high rates of physical aggression that were similar to levels observed in the previous phases. In addition, compliance remained low. These results suggest that simply increasing the duration of escape for compliance under a dense schedule of reinforcement was not effective for increasing compliance and decreasing problem behavior. Therefore, Anna's therapist implemented the enhanced, equated condition in which physical aggression continued to result in a 30-s break; however, compliance now resulted in an "enhanced" 30-s break which included access to her high-preferred toys (i.e., squishy ball and

Play Doh®) and type of attention (i.e., hugging). Under these conditions, Anna's physical aggression decreased to low rates and compliance increased to high levels. Following a reversal to the equated consequences condition in which physical aggression returned to previously high levels, the therapist again implemented the enhanced, equated consequences condition and introduced tokens using an FR 1 exchange schedule. Initially, Anna's physical aggression was low and compliance was high; however, after several sessions, Anna's physical aggression increased and compliance decreased to low levels. These results suggest that increasing the quality of the escape period by adding in preferred leisure items and therapist attention for compliance under a dense schedule of reinforcement was not effective for maintaining decreases in problem behavior and increases in compliance. Next, Anna's therapist implemented the enhanced, un-equated condition in which physical aggression continued to result in a 30-s break; however, compliance now resulted in a 2-min break with preferred items and attention. Under these conditions, Anna's physical aggression quickly reduced to zero rates and compliance increased to high levels. Following a brief reversal to the equated consequences condition in which physical aggression increased and compliance decreased, treatment effects were recaptured upon return to the enhanced, un-equated consequences condition with tokens on an FR 1 exchange schedule.

After stable treatment effects were demonstrated on an FR 1 schedule, the therapist began to systematically thin the exchange schedule using tokens. The criteria by which reinforcement thinning occurred was two consecutive sessions in which there was a 90% reduction in target problem behavior as compared to mean levels of target problem behavior in the control condition, which was the second equated-consequences condition for Anna (denoted by an asterisk on the graph). This 90% reduction line is denoted as the horizontal, red line (.15 RPM)

in the phases in which it was used for thinning decisions. For Anna, once the token exchange schedule was thinned, rates of physical aggression continued to maintain at zero levels and compliance remained at high levels as the token exchange schedule increased from an FR 1 to an FR 2 and on to an FR 4. Following maintenance at the FR 4 schedule, a terminal probe (FR 20) was conducted to determine if treatment effects would maintain under a lean schedule while physical aggression continued to result in a 30-s break (and without having to thin to the terminal schedule). Initially, maintained treatment effects were observed under the terminal schedule. However, there was a bit of a variability in responding for a few sessions until effects were recaptured and maintained over time. These data suggest that a DRA without EXT treatment was effective at decreasing Anna's rates of physical aggression while increasing overall levels of compliance when the magnitude and quality of reinforcement were manipulated to favor compliance. Further, Anna's treatment effects maintained even as the token exchange schedule was rapidly thinned, and even when physical aggression continued to result in reinforcement. A limitation of this evaluation is that it is possible similar effects to those observed in the enhanced, un-equated consequences condition may have occurred had the therapist conducted more sessions in the second enhanced, equated consequences condition. We did not continue conducting sessions in this condition because previous phases suggested that once problem behavior increased and maintained for two sessions, it was likely that it would continue to occur at high levels. Furthermore, although similar increases in physical aggression occurred during the last enhanced, un-equated consequences condition, after each initial increase, responding decreased in a subsequent session.

Results for Queenie are depicted in Figure 12. During the initial equated-consequences condition, Queenie engaged in increasing levels of physical aggression and decreasing levels of

compliance, suggesting that when physical aggression results in the same consequence as compliance (i.e., a 30-s break), the intervention is ineffective. Next, Queenie's therapist implemented the un-equated-consequences condition, and Queenie also engaged in increasing rates of physical aggression and low levels of compliance, which suggests that simply increasing the duration of escape for compliance under a dense schedule of reinforcement in not effective for behavior change. Next, Queenie's therapist implemented the enhanced, equated condition in which Queenie gained access to high-preferred toys (iPad® and tool box play set) and type of attention (conversation). Due to experimenter error, high-preferred edibles were not included in enhanced conditions with Queenie. In this phase, Queenie's physical aggression decreased to zero rates and compliance increased to relatively high levels. Following a reversal to the equated-consequences condition in which physical aggression returned to previously high levels and compliance decreased, Queenie's therapist again implemented the enhanced, equated consequences with token reinforcement. Queenie's physical aggression remained low under a dense FR 1 schedule of reinforcement for compliance in this phase. Next, the therapist implemented schedule thinning with tokens. As with Anna, the criteria by which schedule thinning was implemented was two consecutive sessions in which there was a 90% reduction in physical aggression as compared to mean levels of physical aggression in the control condition, which was the second equated-consequences condition for Queenie (denoted by an asterisk on the graph). This 90% reduction is denoted on the graph as the horizontal, red line (.25 RPM) in the phases in which it was used for thinning decisions. Initially, Queenie's physical aggression was low; however, when the token exchange schedule was thinned to an FR 2 schedule, physical aggression increased and compliance decreased. These results suggest that increasing the quality of the escape period by adding in preferred leisure items and therapist attention for compliance

under a dense schedule of reinforcement was not effective for maintaining low levels of problem behavior and high levels of compliance, particularly as the response requirement was increased to an FR 2. Next, Queenie's therapist implemented the enhanced, un-equated consequences condition, and Queenie's physical aggression quickly reduced to zero rates and compliance increased to high levels. Following a brief reversal to the equated-consequences condition in which physical aggression increased and compliance decreased, treatment effects were recaptured upon return to the enhanced, un-equated consequences condition even with tokens added. After stable treatment effects were maintained on an FR 1 schedule, systematic schedule thinning with tokens was implemented in which the token exchange schedule was gradually increased based on the criteria described above. For Queenie, after the token exchange schedule was thinned, rates of physical aggression maintained at near zero levels and compliance remained at high levels as the response requirement increased from an FR 1 to an FR 2 and on to an FR 4. Following maintenance at the FR 4 schedule, Queenie's therapist conducted a terminal-schedule probe (FR 20) to determine if treatment effects would maintain under a lean token exchange schedule while physical aggression continued to result in a 30-s break. Queenie displayed maintained treatment effects under the terminal-probe schedule. Following a brief reversal to the equated-consequences condition in which physical aggression increased and compliance decreased, treatment effects were not recaptured under the FR 20 terminal schedule. Therefore, Queenie's therapist returned to the previous effective schedule (FR 4) to re-establish treatment effects, then again implemented the systematic schedule thinning procedure. As the schedule was thinned, Queenie's physical aggression maintained at low rates and compliance maintained at high rates, even as the response requirement was thinned to an FR 10. Following maintenance at the FR 10 schedule, Queenie's therapist conducted another terminal-schedule

probe (FR 20) to determine if treatment effects would maintain after schedule thinning to an FR 10. Queenie displayed maintained treatment effects under the terminal schedule for 12 consecutive sessions.

Similar to Anna's results, these data suggest that DRA without EXT was effective at decreasing Queenie's rates of physical aggression while increasing overall levels of compliance when the magnitude and quality of reinforcement were manipulated to favor compliance. Further, Queenie's treatment effects maintained even as the schedule for reinforcement was rapidly thinned from an FR 10 to an FR 20 schedule, and even when physical aggression continued to result in reinforcement. A limitation of Queenie's DRA without EXT evaluation is that although she was approved to receive edible items, due to experimenter error, edible items were not included in her enhanced conditions. Although, her data are a nice replication of robust treatment effects with enhanced, un-equated conditions in which leisure items and attention were provided is effective (also demonstrated by Anna and Janice), it is possible that inclusion of edibles during the enhanced condition may have influenced the results. That is, it is possible that the inclusion of edibles would have resulted in effects during the enhanced, equated condition or earlier in the enhanced, un-equated condition.

Results for Brock are depicted in Figure 13. During the initial equated-consequences condition and un-equated consequences condition, Brock engaged in high levels of physical aggression and low levels of compliance during 5-min sessions. During the first enhanced, equated consequences condition in which Brock gained access to high-preferred toys (iPad® and baton), edible items (Cheez Its®, Snickers®, and Doritos®), and a high-preferred type of attention (facial expressions), Brock's physical aggression decreased to near zero rates and compliance increased to relatively high levels, even as the session duration was increased to 10

min. Following a reversal to the equated consequences condition in which physical aggression returned to previously high levels and compliance decreased, Brock's therapist again implemented the enhanced, equated consequences condition, but with tokens. With the exception of a few initial sessions, under the FR 1 schedule, Brock engaged in low levels of physical aggression and relatively high levels of compliance. However, as schedule thinning was implemented, physical aggression increased and compliance decreased after the schedule increased, resulting in the therapist moving a step back in the response requirement. Following stability under an FR 4 was reached, the therapist conducted a terminal-schedule probe and observed relatively high levels of aggression and moderate levels of compliance. Next, when the therapist returned to schedule thinning, treatment effects were lost in attempts to thin the schedule. These results suggest that increasing the quality of the escape period by adding in preferred leisure items, edible items, and therapist attention for compliance under a dense schedule of reinforcement was an effective intervention under low response requirements; however, after the response requirement was increased to an FR 6, treatment effects were lost and could not be regained even after moving back to a denser FR 4 schedule. Next, under enhanced, un-equated consequence conditions, Brock's physical aggression quickly reduced to near zero rates and compliance increased to high, stable levels. Following a brief replication of effects under the equated-consequences condition, treatment effects were recaptured upon return to the enhanced, un-equated consequences condition even when tokens were introduced under an FR 1 schedule. After stability of treatment effects was demonstrated on an FR 1 schedule of reinforcement, systematic schedule thinning with tokens was implemented. Brock's rate of physical aggression maintained at near zero rates and compliance remained at high levels, even as the token exchange schedule increased from an FR 1 to an FR 2 and on to an FR 4.

Following maintenance at the FR 4 schedule, the therapist conducted a terminal probe (FR 20) to determine if treatment effects would maintain under a lean schedule without having to systematically thin to the terminal schedule. Initially, maintained treatment effects were observed under the terminal schedule. However, treatment effects were lost after one session as rates of physical aggression continued to increase and levels of compliance decreased to relatively lower levels. Therefore, Brock returned to the leanest schedule of reinforcement that previously demonstrated treatment effects (i.e., FR 4) and treatment effects were re-established under this denser schedule of reinforcement. After stable treatment effects were demonstrated on an FR 4 schedule of reinforcement, the therapist again began systematically thinning the schedule. For Brock, rates of physical aggression continued at near zero rates and compliance remained at high levels as the token exchange rate increased from an FR 4 to an FR 6, then on to FR 8 and FR 10. Following maintenance at the FR 10 schedule, another probe of Brock's performance under a leaner exchange schedule (FR 20) was conducted to determine if treatment effects would maintain following thinning to a higher schedule. Maintenance of treatment effects was demonstrated across three consecutive sessions; however, like before, treatment effects were lost after the third session as rates of physical aggression continued to increase and levels of compliance decreased to relatively lower levels. Thus, Brock returned to the thinnest exchange schedule that previously demonstrated treatment effects (FR 10), and treatment effects were re-established. After stable treatment effects were demonstrated on an FR 10 schedule, systematic thinning of the exchange schedule was implemented once again. For Brock, rates of physical aggression continued to stay at near zero rates and compliance remained at high levels as the response requirement increased from an FR 10 to an FR 12, then on to an FR 14 and FR 16. However, following the introduction of the FR 16 schedule, treatment effects were lost and

attempts to return to thinner schedules (FR 14 and FR 12) were ineffective. Therefore, we continued to move back to denser schedules to re-establish treatment effects. After Brock reached the FR 10 schedule, rates of physical aggression returned to zero levels and levels of compliance maintained at high, stable levels. Maintenance of treatment effects was demonstrated across 10 consecutive sessions at this schedule. Similar to Anna's and Queenie's results, these data suggest that a DRA without EXT treatment was effective at decreasing Brock's rate of physical aggression while increasing overall levels of compliance when the magnitude and quality of reinforcement were manipulated to favor responding toward compliance. Further, although Brock's treatment effects did not maintain at an FR 20 schedule, his responding did become stable under an FR 10 schedule, which represents a relatively lean alternative as compared to the initial FR 1 schedule.

Results for Janice are depicted in Figure 14. During the initial equated-consequences condition, Janice engaged in low levels of problem behavior (i.e., physical aggression and SIB) and increasing levels of compliance when both problem behavior and compliance resulted in a 30-s break on an FR 1 schedule across 5-min sessions. Next, Janice's therapist implemented the baseline condition in which problem behavior continued to result in a 30-s break; however, compliance only resulted in praise. Janice engaged in high levels of problem behavior and decreasing levels of compliance in baseline. Janice's therapist then implemented the equated-consequences condition and recaptured treatment effects across 5-min sessions; however, after session length was increased to 10 min, rates of problem behavior increased and compliance decreased to similar levels as observed in baseline. These data suggest that 30-s breaks for compliance might initially maintain responding on a dense schedule when sessions are 5 min in length; however, after Janice experienced longer session durations and subsequently longer

exposure to relevant EOs, responding shifted away from compliance and toward problem behavior to access escape. Next, Janice's therapist implemented the un-equated consequence condition with no effect, suggesting that simply increasing the duration of escape for compliance under a dense schedule of reinforcement was not effective. Next, Janice's therapist implemented the enhanced, equated consequence condition in which an "enhanced" break for compliance resulted in access to her high-preferred leisure item (i.e., blanket) and type of attention (i.e., conversation). Under these conditions, Janice's problem behavior decreased to low rates and compliance increased to high levels over time. Following a reversal to the equated-consequences condition in which problem behavior returned to previously high levels and compliance decreased, Janice's therapist again implemented the enhanced, equated-consequences condition but without replicated effects. Next, Janice's therapist implemented the enhanced, un-equated consequence condition, which resulted in an initial treatment effect that was followed by an increase in problem behavior and decrease in compliance. Next, Janice's therapist implemented the enhanced, un-equated condition but with a 4 min rather than a 2 min break for compliance. Under these conditions, Janice's problem behavior immediately reduced to zero and levels of compliance increased to maintained high levels. Following a brief reversal to the enhanced, equated consequences condition, treatment effects were recaptured upon return to the enhanced, un-equated (4 min) consequences condition with tokens added. After stable treatment effects were demonstrated on an FR 1 schedule, systematic thinning of the exchange schedule with tokens was implemented in which the response requirement to access a break was gradually increased based on the 90% reduction criteria. For Janice, after the token exchange schedule was thinned, rates of problem behavior maintain at zero levels and compliance remained at high, stable levels as the exchange rate increased from an FR 1 to an FR 2 and on to an FR 4.

Following maintenance at the FR 4 schedule, a terminal-schedule probe (FR 20) was conducted to determine if treatment effects would occur under a lean schedule without systematic thinning to that schedule. Maintenance of treatment effects was demonstrated initially across six consecutive sessions. However, throughout this phase, compliance continued to decrease substantially. Eventually, treatment effects began to deteriorate as sessions with increased rates of problem behavior became frequent and more consistent. Therefore, Janice's therapist returned to the thinnest schedule that previously demonstrated treatment effects (FR 4) and following a session with high rates of problem behavior, treatment effects re-established under this denser schedule. Once stable treatment effects were demonstrated on an FR 4 schedule of reinforcement, systematic thinning of the exchange schedule with tokens was again implemented. For Janice, rates of problem behavior maintained at zero levels and compliance remained high, though sometimes variable, as the response requirement increased from an FR 4 to an FR 6, then on to FR 8 and FR 10. Following maintenance at the FR 10 schedule, another terminal-schedule probe was conducted. Maintenance of treatment effects was demonstrated across four consecutive sessions; however, like before, treatment effects were lost after the fourth session as rates of problem behavior increased and levels of compliance decreased. Because Janice's responding following an increase in problem behavior during the lean schedule of reinforcement continued to occur at high rates in the previous probes of the lean schedule, Janice's therapist returned to the thinnest schedule that previously demonstrated treatment effects (FR 10) and treatment effects were re-established under this denser schedule of reinforcement. After stable treatment effects were demonstrated on an FR 10 schedule, systematic thinning of the exchange schedule with tokens was implemented once again. After multiple attempts to thin the schedule, treatment effects continued to breakdown. Therefore, Janice's therapist attempted

to replicate the initial effects of the intervention by showing maintained treatment effects under the FR 1 schedule, which was demonstrated in the last seven consecutive sessions. A limitation of Janice's procedures is that we did not evaluate the increase in magnitude from 2 min to 4 min in isolation prior to combining it with the quality manipulation. Therefore, it could have been that a magnitude manipulation in which compliance resulted in a 4-min break could have been just as effective. Thus, future researchers should evaluate the effectiveness of magnitudes of escape to determine if behavior is sensitive to this dimension under longer durations of escape. Although results of numerous basic studies with nonhuman subjects suggest that magnitude can influence responding (e.g., Catania, 1963), previous research in applied settings have shown inconsistent results (e.g., Lerman, Kelley, Van Camp, & Roane, 1999; Vollmer, Borrero, Lalli, & Daniel, 1999). Therefore, research in this area is needed, especially for the effects of magnitude on the efficacy of social-negative reinforcement.

General Discussion

In these studies, we attempted to address several questions that we hoped would be important for both clinicians and researchers in the assessment and treatment of severe problem behavior. In Study 1, we replicated other studies showing that latency-based FAs can demonstrate clear functions for severe problem behavior (physical aggression and SIB) in a relatively safe and efficient manner. For example, we only needed to observe on average nine instances of problem behavior (range, 3-20 instances) and spent an average time of 85.29 min (range, 46.45 min – 161.13 min) in the assessment (data can be found in Table 4). These results are important for clinicians and researchers to consider when functions of dangerous instances of severe problem behavior need to be determined in a safe and efficient manner.

Although the results of Study 1 add to the small literature on the utility of this FA methodology as well as the generality and robustness of its effects, there are some limitations worth mentioning. First, in our current procedures, we conducted two separate tangible conditions (leisure and edible item) in order to determine if participants were sensitive to either one or both as a reinforcer prior to delivering it contingent on an appropriate alternative response. Although it was a useful procedure for our purposes, we do not recommend that clinicians conduct two separate tangible conditions. We make this recommendation because conducting separate tangible conditions will result in an increased time spent in assessment and is not likely to provide clinicians with much more useful information if they were all combined into one tangible condition. Second, although research has shown the divided-attention condition to be useful, it is possible that for some individuals the presence of two adult teachers or therapists conversing might be a discriminative stimulus for engaging in prosocial behavior (e.g., appropriate waiting or politely requesting for attention) or an S-delta for problem behavior (or responding in general). However, given our population, we chose to use this modified test condition because of its similarity to the deprivation from attention conditions our participants experienced on a daily basis. Third, we did not collect data on problem behavior between sessions, which limits our ability to make confident assertions regarding the potential safety and time efficiency of the latency-based FA. That is, given that we instituted a calm criterion of 3 min between sessions, if problem behavior was occurring at the end of a session and observers did not collect data on (a) the frequency and duration of problem behavior during these periods of time or (b) the duration of these periods of time, then it is unknown whether these FAs were in fact potentially safer and more efficient. Anecdotally, therapists reported observing very little ongoing episodes of problem behavior following FA (and DRA without EXT) sessions in which

problem behavior occurred at the end of session. Further, escalation of problem behavior within FA sessions never resulted in session suspension criteria as the participant always calmed for 3 min within a 10-min window. However, future researchers should collect and report on these measures if their purpose is to make meaningful comparisons or claims regarding the safety and efficiency of the assessment and treatment procedures. Fourth, a major limitation remains with respect to interpreting the results of the FAs because our treatment was not designed to validate the outcomes of the FA. Therefore, it may have been useful to confirm or deny the suspected functions of participants FAs which were unclear (i.e., Brock) through further analyses using a test-control pairwise design. Future researchers should continue to evaluate the effectiveness of latency-based FAs when further analyses need to be conducted or modifications need to be made to determine if latency-based FAs continue to be an ideal method for identifying functions for difficult to assess behaviors or functions.

In Study 2, we replicated previous research in several ways. First, similar to Athens and Vollmer (2010) and Hoch et al. (2002), we showed that equated consequences failed to produce maintained treatment effects for all four participants. Second, we replicated previous research (Hoch et al., 2002) showing that manipulating both the magnitude and quality of reinforcement to favor the alternative response, resulted in robust effects for all four participants. Third, we replicated Hoch et al. showing that treatment effects maintained over time as reinforcement schedule thinning was implemented for compliance for three out of four participants. The replication of these results and a determination of the various DRA without EXT conditions under which the results are and are not found provide useful information for clinicians regarding the utility of DRA without EXT and provide additional support for continued research in this area. For instance, researchers might continue to pursue a line of research to determine the

conditions under which magnitude of negative reinforcement is a valuable dimension alone (e.g., under higher durations) or in conjunction with multiple other dimension manipulations such as delay and quality.

The results of Study 2 also extend previous research on DRA without EXT procedures in several ways. First, we arranged the order of conditions such that history effects with respect to previous conditions were controlled for as participants progressed through conditions of the study. Many studies that have compared the effects of DRA without EXT (equated consequences) to DRA without EXT (enhanced, equated consequences) have conducted the latter condition prior to the former condition, and results have shown DRA without EXT (enhanced, equated consequences) is more effective (e.g., Hoch et al., 2002). Thus, it is unknown whether this history influenced the efficacy of DRA without EXT (equated consequences) due to the removal of access to positive reinforcers in the subsequent DRA without EXT (equated consequences) condition. Furthermore, the progression of DRA without EXT conditions allowed for us to isolate the necessary and sufficient conditions under which therapeutic effects might be obtained. That is, some studies have shown the effects of DRA without EXT after a history of DRA *with* EXT (e.g., Lalli et al., 1999). Therefore, we removed this history by beginning the evaluation with DRA without EXT (equated consequences).

Second, we compared the effects of single and combined dimensions of magnitude and quality of reinforcement both within and across subjects. Specifically, because of our predetermined condition arrangement, we were able to evaluate the influence of magnitude of negative-reinforcement in isolation, the influence of quality during an enhanced break in isolation, and the influence of the combination of magnitude and quality for all four participants in the treatment of problem behavior maintained by social-negative reinforcement in the absence

of EXT (see Table 8 for summary of outcomes). Overall, the influence of isolated dimensions was either ineffective (i.e., magnitude) or somewhat effective under dense schedules (i.e., quality); however, when dimensions were combined they had a synergistic effect on participants responding. In other words, when these dimensions were combined they produced robust treatment effects for all four participants which supported maintenance under lean schedules of reinforcement for three out of four participants. As noted in the review of limitations in this area of research, studies that have attempted to evaluate the specific order in which dimensions are manipulated in isolation or in combination have done so following a history in which both dimensions were combined. However, future research might consider counterbalancing order across a large number of participants to determine if initial robust effects from combined dimensions results in better long term-outcomes as compared to participants who initially experience dimensions in isolation. Additionally, because progression through the DRA without EXT treatment evaluation included increasing periods of breaks (i.e., from 30-s to 2-min breaks for Anna, Brock, and Queenie and on to a 4-min break for Janice), it may be that rates of target problem behavior may differ across conditions if access to reinforcement periods were removed. Therefore, future researchers should divide session time into “work time” (or, EO-on period) and “break time” (or, EO-off period) and calculate separate rates based on these durations. Using rates from the EO-on period would provide a measure that could be compared across conditions with differing EO-off periods due to the difference in magnitude across conditions. Finally, as there was less “work time” across conditions, it may be that there were also fewer tasks being completed as the DRA without EXT treatment evaluation progressed. Therefore, although compliance remained high, it may be that participants experienced fewer demands. Thus, future

researchers should monitor the frequency of tasks completed across phases to compare the amount of demands presented and completed within and across sessions and phases.

Third, we found results that are contrary to that of previous applied DRA without EXT research suggesting an increase in the magnitude (i.e., duration) of the functional reinforcer to favor the alternative response may be a potentially effective manipulation when severe problem behavior still results in reinforcement (Athens & Vollmer, 2010). That is, we found this manipulation alone was ineffective for all four participants. However, it is unclear whether longer durations would have been more effective. Future researchers should consider conducting further evaluations in which magnitude of social-negative reinforcement is manipulated in an attempt to influence responding within the context of DRA without EXT. Because magnitude may be a dimension of reinforcement that is difficult for participants to discriminate differences between duration, one approach might be to program discriminative stimuli to signal the durations or to use more definitive durations (e.g., the rest of the day) to enhance the saliency and potential effectiveness of this dimension of reinforcement.

Fourth, we used tokens during reinforcement schedule thinning to help signal the response requirement with a clear exchange schedule to add to the effects of systematic thinning. The results suggested that use of tokens provided a relatively easy method for systematically thinning the schedule of reinforcement by increasing the token exchange rate which perhaps aided in the success of our thinning for three of the four participants by either functioning as a conditioned reinforcer or by signaling the delay to reinforcement (Hackenberg, 2009). An interesting finding with the use of the tokens was that for all four participants we were able to rapidly thin the schedule from an FR 4 to an FR 20 for at least a couple sessions for Brock and more sessions for Anna, Janice and Queenie. However, for two of the four participants (Brock

and Janice), effects were not maintained after rapid thinning, suggesting that whatever function the tokens served, they quickly lost their effects. Recent research has demonstrated that tokens serve multiple functions (Bullock & Hackenburg, 2015) and suggested that future research should determine under what conditions one function or another will come to predominate. An understanding of these conditions would result in a more sophisticated approach towards programming token arrangements which could lead to more robust and durable treatment effects. However, because we did not evaluate reinforcement schedule thinning with and without the use of tokens, we cannot speak directly to the effects that the tokens played in the success of the schedule thinning. Therefore, future researchers may choose to evaluate thinning in the absence of tokens as compared to thinning with tokens to determine if one approach is more superior. In addition, based on the decrease in treatment effects with schedule thinning for Brock and Janice, it may be that we thinned too rapidly, thus producing ratio strain (Ferster & Skinner, 1957). Therefore, it might be beneficial to systematically determine the most effective and efficient method for schedule thinning. Further, it is possible that tokens became aversive because they were associated with rapid increases in schedule requirements. In fact, Janice would request, “no tokens” prior to the start of session. One way to determine whether the tokens became aversive is to compare pauses in responding following reinforcement delivery when tokens were and were not delivered and as token-exchange schedules were thinned (Powell, 1968). If pauses are longer under token schedules or leaner token schedules, these data might suggest that the tokens are aversive (i.e., they have become discriminative aversive stimuli due to their association with an increased response effort or time required to obtain the next reinforcer; Holz & Azrin, 1966). Given this possibility, it would be interesting to evaluate the effects of other less predictable

schedules of reinforcement for promoting maintenance and generalization such a VR or random-ratio (RR) schedules.

Although we were able to effectively thin the schedule to FR 20 for two of the four participants (Anna and Queenie), it should be noted that this was an arbitrary designation and determination of "practical" work schedules should be functionally defined based on the conditions under which certain schedules are effective for both participant and therapist while producing a maximum level of maintenance and generalization. For instance, although the FR schedule used in the present evaluation was manageable and effective for all four participants, delivering tokens on a continuous FR 1 schedule or even delivering the enhanced, un-equated consequence following an FR 20 schedule may not be practical across all environments. Further, research on the use of ratio schedules within a concurrent-operants arrangement suggests limitations that may interfere with desired results (e.g., deviations in matching; Herrnstein & Loveland, 1975). Thus, determining practicality of reinforcement schedules should be based on our knowledge of effective schedules while also considering the context with which they are to be implemented. Discussion regarding the type of reinforcement schedules that are most similar to those that are naturally occurring in our everyday environment (e.g., dependent RR schedules; Rothstein, Jensen, & Neuringer, 2008) is important because programming these might be the most practical as they would also likely lend themselves to promoting generalization across settings, therapists, and time. In summary, future research should involve continued investigation regarding practical and effective schedules of reinforcement that are likely to promote maintenance and generalization.

The results of Study 2 also contribute to the growing body of literature on the use of positive reinforcement in the treatment of problem behavior maintained by social-negative

reinforcement (Payne & Dozier, 2013). Although results of these studies show a large reduction in problem behavior for all participants, the mechanism by which these effects are obtained is unclear. Lalli et al. (1999) and Adelinas et al. (2001) discussed two possible explanations for these findings. First, these outcomes might be explained in terms of the principles of choice responding in which the alternative response and problem behavior are concurrent operants and the participants' motivation for positive reinforcers is greater than their motivation for escape, resulting in more responding toward the alternative response. In other words, positive reinforcers such as edibles, attention, or preferred leisure items, might simply be more preferred than escape, even though escape is the variable maintaining problem behavior (DeLeon, Iwata, & Roscoe, 1997; Lalli et al., 1999). Second, the provision of positive reinforcement during the instructional context may function as an abolishing operation (AO) that momentarily decreases the value of escape, and in turn, decreases problem behavior to access it. This hypothesis is supported in work conducted by Lomas, Fisher, and Kelley (2010) who showed that the noncontingent delivery of edible items was effective in decreasing levels of problem behavior to access escape. Although these two explanations have been discussed in the literature, it is possible that one or both mechanisms are operating across different individuals. It may be important to determine the precise mechanism for the effects of positive reinforcement on escape-maintained problem behavior for a particular individual because this information may allow us to determine additional procedures or interventions that might be needed. That is, if the value of escape remains unaltered (rather, its value was momentarily overridden by the value of food) and the escape contingency remains intact for problem behavior, participants' problem behavior is likely to continue to contact the functional reinforcer as the schedule is thinned (as has been shown in various studies), or if integrity failures occur, resulting in a re-emergence of

problem behavior. By contrast, if the presence of the positive reinforcer altered the value of escape rather than overrode the value of the negative reinforcer, then it may be less likely to observe re-emergence of problem behavior because there should be little to no motivation to escape from the instructional context, even as the schedule is thinned or if integrity failures occur. However, this is an empirical question and future researchers should consider evaluating the mechanism of positive reinforcement in the treatment of problem behavior maintained by social-negative reinforcement by manipulating relative satiation and deprivation of positive reinforcers used in aversive contexts in addition to determining their relative effectiveness under varying degrees of aversive contexts when an alternative response (e.g., problem behavior) continues to result in brief escape from the aversive context. Further, we provided pre-determined positive reinforcers for compliance during the enhanced conditions; however, we may have observed better treatment effects under these conditions if participants were provided choices within session with respect to the positive reinforcers delivered during the break. For example, sometimes participants' might not want attention or may want a different type of attention during the break.

Additionally, further research manipulating the quality dimension of reinforcement for problem behavior maintained by social-negative reinforcement should include alternative methods for manipulating this dimension. As noted above, quality of social-negative reinforcement typically has been manipulated by providing positive reinforcers either during break periods or for engaging in an appropriate alternative response. However, there are several other potential methods for manipulating quality of social-negative reinforcement that researchers should consider investigating. For instance, responding to access a less effortful task may be a quality of social-negative reinforcement which could be manipulated to influence

response allocation when options between tasks of varying amounts of effort are presented within a concurrent-operants arrangement. For example, Miller (1968) investigated the likelihood that participants would learn to escape from a situation requiring an effortful response (operating mechanism requiring 20-lb force) to an easier response (operating mechanism requiring 1-lb force). Results suggested that escape responding could be reinforced and maintained to access this relatively higher-quality escape period. Thus, the relative value (or, quality) of escape may be directly related to the other available options and research suggests this dimension could be manipulated to influence response allocation. Therefore, future researchers might consider additional approaches for manipulating quality of social-negative reinforcement for individuals with escape-maintained problem behavior. For example, researchers may evaluate the effects of a treatment for problem behavior where compliance might result in a 30-s break to a less effortful activity while problem behavior results in a 30-s break from the present work to a more effortful activity.

With respect to the function of problem behavior predicting the effectiveness of our present evaluation, most studies showed problem behavior was either maintained by multiple social reinforcers (Adelinas et al., 2001; Athens & Vollmer, 2010; DeLeon et al., 2001; Hoch et al., 2002; Lalli & Casey, 1996; Piazza et al., 1997) or the relation between problem behavior and certain social reinforcers was unknown because researchers did not examine these relations in a pretreatment experimental FA (Slocum & Vollmer, 2015). Therefore, it is unclear whether the quality manipulation was effective because problem behavior was also sensitive to positive reinforcement. Due to the small number of participants with a limited range of maintaining variables for their problem behavior within our study, we are limited in our ability to make any comparisons between the outcome of FAs and the effects of DRA without EXT conditions for

particular participants. Therefore, future researchers may want to conduct large-*N* studies to determine if there is a correlation between the outcome of different dimensions of reinforcement in DRA without EXT and the functional variables maintaining problem behavior. Finally, replications and extensions across populations, topographies of severe problem behavior, and combinations of different dimensions of reinforcement are needed to determine the generality of these procedures.

Overall, the results from Study 1 and Study 2 suggest that functions of problem behavior can be identified in an efficient and potentially safe way and that effective treatments can be developed in the absence of EXT by manipulating a combination of magnitude and quality of reinforcement for compliance, which can be maintained at lean schedules of reinforcement with the use of tokens. These results have important clinical implications because EXT might not always be an option for a number of reasons, and the results of this study provide further evidence of the effectiveness of alternative strategies to alleviate these concerns. Further, because potent reinforcers were identified and delivered for compliance, this treatment approach might be more practical for caregivers to implement because their focus could be on increasing compliance, thus increasing overall learning opportunities. Finally, because procedures were developed for effectively thinning the schedule of reinforcement for compliance while problem behavior continued to result in the functional reinforcer, this information should help to inform a manageable level of implementation for caregivers, thus leading to long-term maintenance and generalization of therapeutic effects.

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Tables and Figures

Table 1

Participant characteristics

Participant	Age	Gender	Diagnosis	School setting	Service
Anna	4	Female	Autism	Early intervention	Intensive behavioral intervention
Brock	16	Male	Autism	Private school	Intensive behavioral services
Janice	14	Female	Autism	Private school	Intensive behavioral services
Queenie	5	Female	Global developmental delay	Preschool	Individualized assessment and intervention services

Note. The table depicts the age in years, gender, diagnosis, school setting, and type of service of each participant at the start of the study.

Table 2

Operational definitions for the topographies of problem behavior

Behavior	Participants	Definition
Hitting	All	Attempt or occurrence of forceful contact of the participant's hand or fist and another person.
Pushing	Anna, Queenie, Brock	Attempt or occurrence of the placement of one or two hands on the therapist followed by an attempt to forcefully displace the therapist.
Kicking	Queenie	Attempt or occurrence of forceful contact of the participant's foot to another person.
Biting	Janice	Attempt or occurrence of the closure of the participant's teeth around the skin or clothes of another person.
Scratching	Janice	Attempt or occurrence of contact and subsequent movement of the participant's fingernails along the therapist's skin or clothes; each hand constitutes a separate instance of the behavior.
Body-to-object	Janice	Attempt or occurrence of forceful contact of any part of the participant's body to a surface.
Hand-to-body	Janice	Attempt or occurrence of forceful contact of the participant's hand to another part of their own body.

Table 3

Summary of high-preference stimuli for all participants

Participant	Leisure item(s)	Edible item(s)	Attention type(s)
Anna	Squishy ball Play Doh	n/a	Hugs
Brock	iPad Baton	Snickers Cheez It	Facial expression
Janice	Blanket	n/a	Conversation
Queenie	iPad Tool box	Cheetos Goldfish	Conversation

Note. Summary of high-preferred leisure item(s), edible item(s), and attention type(s) for all participants. High-preferred leisure items were used within the tangible and play conditions. All high-preferred items were used within the "enhanced" quality manipulation of the DRA without EXT treatment evaluation.

Table 4

Outcomes of latency and derived standard functional analyses

	Latency		Standard	
Participant	Total duration	No. of responses	Total duration (derived)	No. of responses (derived)
Anna	46.45 min	4	60 min (+13.55)	15 (+9)
Brock	54.76 min	20	125 min (+70.2)	57 (+37)
Janice	161.13 min	9	190 min (+28.9)	45 (+36)
Queenie	78.83 min	3	90 min (+11.2)	21 (+18)

Note. Total assessment duration and total number of responses for participants throughout the latency-based FA compared to derived total assessment duration and total number of responses to a standard FA.

Table 5

Safety Indicators

Participant	Terminated sessions	Sessions suspended	Injuries due to SIB	First aid needed for participant	First aid needed for therapist
Anna	0	0	n/a	0	0
Brock	0	0	n/a	0	0
Janice	0	0	0	0	1
Queenie	0	0	n/a	0	0

Note. Summarizes the number of instance in which sessions were terminated, sessions were suspended, injuries were reported due to SIB, and first aid needed to be completed for either the participant or the therapist for each participant during the latency-based FA.

Table 6

Operational definitions of types of attention included in the attention and reinforcer assessments

Participants			
Anna	Brock	Janice	Queenie
Tickles: Therapist places two hands on the participant's upper arm and moves fingers back and forth in a repetitive motion in one spot while smiling and making eye contact.	Tickles: Therapist places two hands on the participant's upper arm and moves fingers back and forth in a repetitive motion in one spot while smiling and making eye contact.	Tickles: Therapist places two hands on the participant's upper arm and moves fingers back and forth in a repetitive motion in one spot while smiling and making eye contact.	Tickles: Therapist places two hands on the participant's upper arm and moves fingers back and forth in a repetitive motion in one spot while smiling and making eye contact.
Praise: Therapist says, "Nice job Anna, you're the best" while making eye contact and smiling after the statement.	Praise: Therapist says, "You the man, Brock!" while making eye contact and smiling after the statement.	Praise: Therapist says, "I'm so proud of you, Janice!" while making eye contact and smiling after the statement.	Praise: Therapist says, "You're a rockstar, Queenie!" while making eye contact and smiling after the statement.
Head/neck rubs: Therapist places two hands above the participants head and moves fingers back and forth in a repetitive motion on top of the head while working down to the back of the neck while smiling and making eye contact.	Head/neck rubs: Therapist places two hands above the participants head and moves fingers back and forth in a repetitive motion on top of the head while working down to the back of the neck while smiling and making eye contact.	Head/neck rubs: Therapist places two hands above the participants head and moves fingers back and forth in a repetitive motion on top of the head while working down to the back of the neck while smiling and making eye contact.	Head/neck rubs: Therapist places two hands above the participants head and moves fingers back and forth in a repetitive motion on top of the head while working down to the back of the neck while smiling and making eye contact.
Conversation: Therapist engages in one exchange about one of the three topic areas (i.e., clothes, snack, playing outside) while smiling and making eye contact.	Conversation: Therapist engages in one exchange about one of the three topic areas (i.e., clothes, The Wiggles, lunch) while smiling and making eye contact.	Conversation: Therapist engages in one exchange about one of the three topic areas (i.e., decorating bedroom, decorating classroom, daily schedule) while smiling and making eye contact.	Conversation: Therapist engages in one exchange about one of the three topic areas (i.e., playing outside, toys from home, toys in classroom) while smiling and making eye contact.

(Continued)

(Table 6 Continued)

Participants			
Anna	Brock	Janice	Queenie
Hugs: Therapist opens up arms toward the participant while smiling and making eye contact and wraps both arms around the participant, squeezing gently.	Facial expressions: Therapist makes sustained eye contact while smiling and nodding head.	Hugs: Therapist walks around the participant while smiling and making eye contact and from the side slightly behind wraps both arms around the participant, squeezing gently.	Hugs: Therapist opens up arms toward the participant while smiling and making eye contact and wraps both arms around the participant, squeezing gently.
Hand holding: Therapist holds one of the participant's hands with fingers intertwined and places the other hand on top of the hands that are clasped while smiling and making eye contact.	Clapping: Therapist claps hands while making eye contact and smiling at the participant.	Back rubs: Therapists walks around the participant while smiling and making eye contact and from the sidea and slightly behind places two hands on the participants back and moves fingers back and forth in a repetitive motion.	High fives: Therapist raises both hands and makes contact with the participant's palms repetitively so that each contact makes a clapping sound, makes eye contact, and smiles at the participant.
Silly faces: Therapist closes eyes and sticks out tongue or grabs ears and puffs cheeks while smiling and laughing.	Hand holding: Therapist holds one of the participant's hands with fingers intertwined and places the other hand on top of the hands that are clasped while smiling and making eye contact.	Hand holding: Therapist holds one of the participant's hands with fingers intertwined and places the other hand on top of the hands that are clasped while smiling and making eye contact.	Facial expressions: Therapist makes sustained eye contact while smiling and nodding head.

Table 7

Summary of DRA without EXT contingencies for problem behavior and compliance across conditions

Conditions	Problem behavior	Compliance
Baseline	30-s escape	Praise
Equated	30-s escape	30-s escape
Un-equated	30-s escape	2-min escape
Enhanced, equated	30-s escape	30-s escape with HP stimuli
Enhanced, un-equated (2 min)	30-s escape	2-min escape with HP stimuli
Enhanced, un-equated (4 min)	30-s escape	4-min escape with HP stimuli

Table 8

Summary of outcomes across treatment evaluation conditions for all participants

Participant	Equated	Baseline	Un-Equated	Enhanced, Equated	Enhanced, Un-Equated (2 min)	Enhanced, Un-Equated (4 min)
Anna	YES; ineffective following history of BL	NO	NO	YES; ineffective following history of Equated	YES; rapidly thinned to FR 20 after FR 4 and maintained effects	n/a
Queenie	NO	n/a	NO	YES; ineffective at FR 2	YES; rapidly thinned to FR 20 after FR 10 and maintained effects	n/a
Brock	NO	n/a	NO	YES; ineffective at FR 4	YES; thinned to FR 10 and maintained effects	n/a
Janice	YES; ineffective when increased session duration to 10 min	NO	NO	YES; ineffective following history of Equated	NO	YES; only maintained effects at FR 1

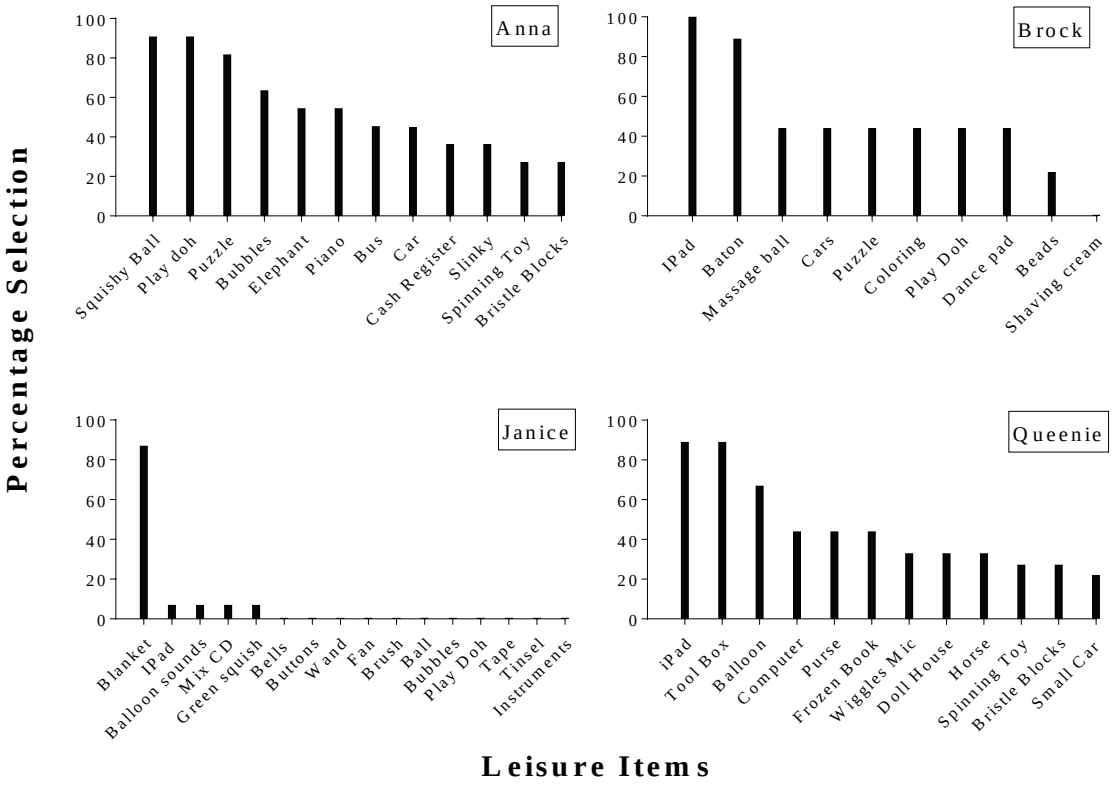


Figure 1. Leisure item paired-stimulus preference assessment results for Anna (top left), Brock (top right), Janice (bottom left), and Queenie (middle right). Leisure items are scaled along the x-axis and percentage of selection is scaled along the y-axis.

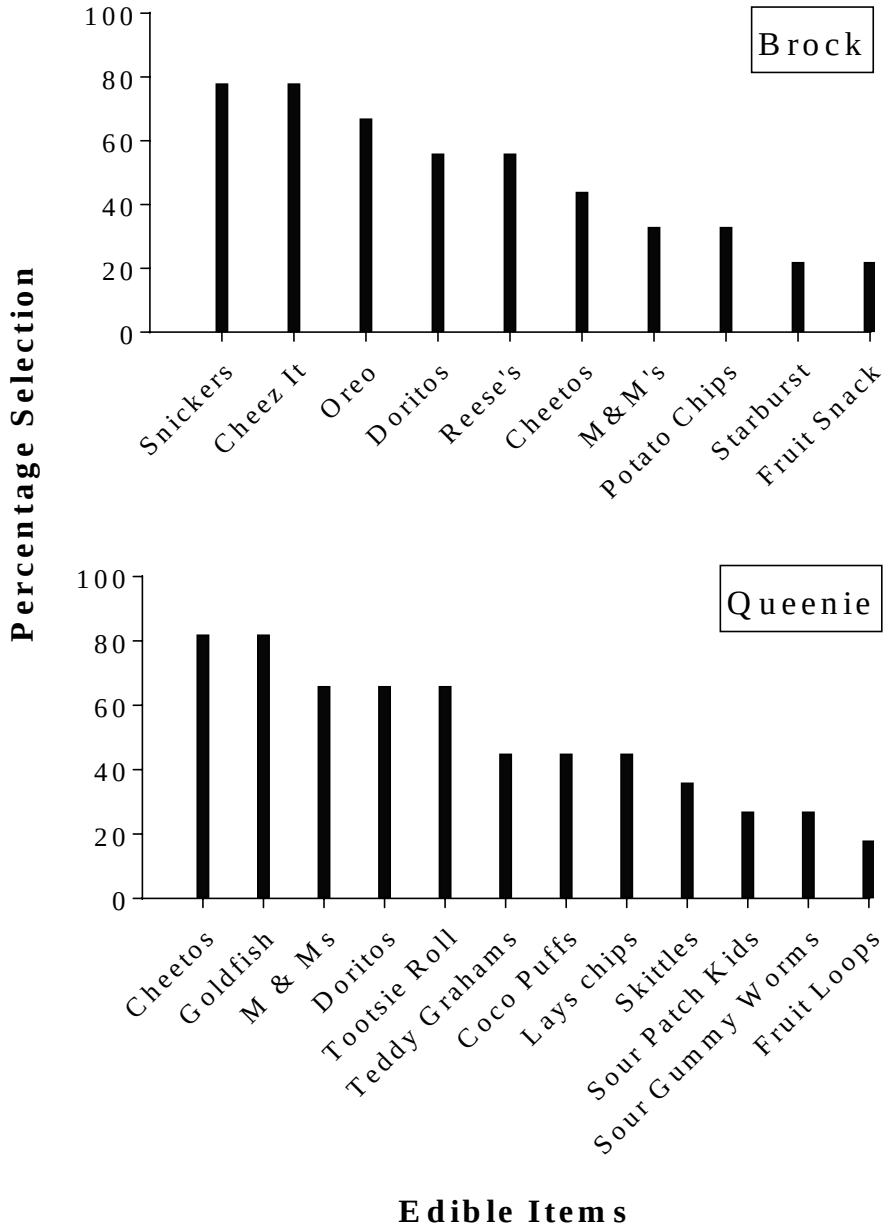


Figure 2. Edible item paired-stimulus preference assessment results for Brock (top) and Queenie (bottom). Edible items are scaled along the x-axis and percentage of selection is scaled along the y-axis.

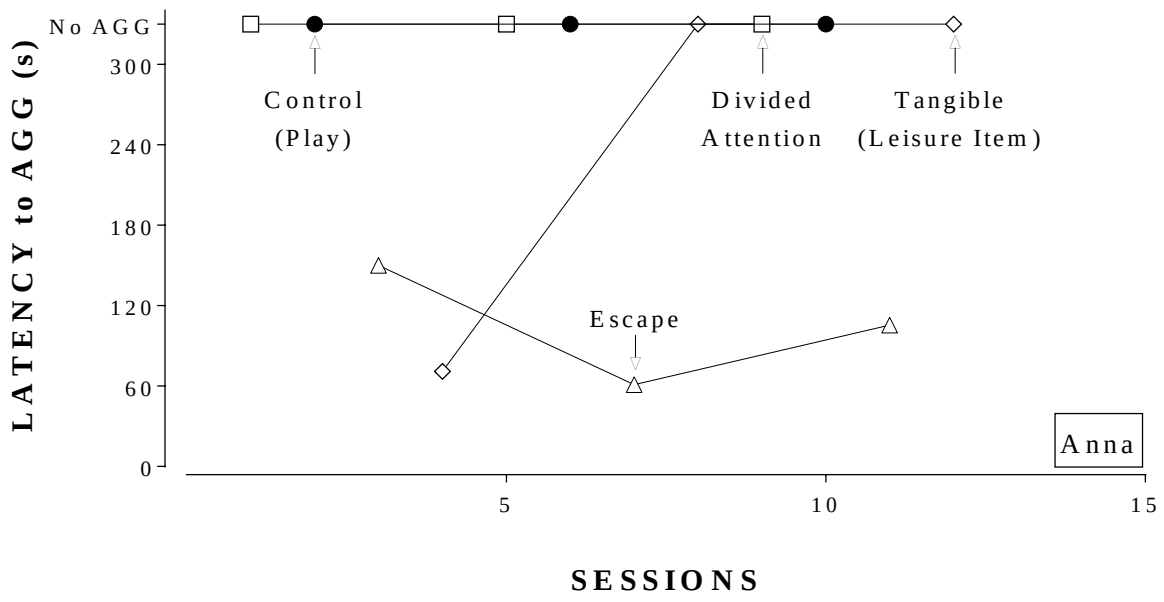


Figure 3. Latency-based FA results for Anna's physical aggression across the divided-attention (open squares), control (closed circles), escape (open triangles), and tangible (leisure item; open diamond) conditions. Results indicate Anna's physical aggression was maintained by escape.

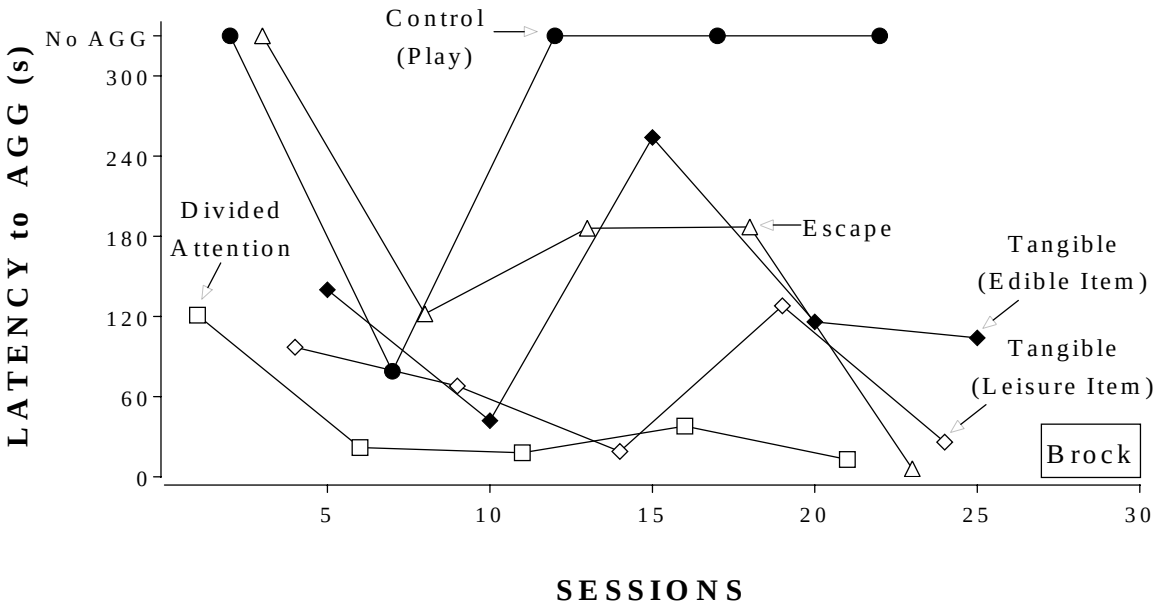


Figure 4. Latency-based FA results for Brock's physical aggression across the divided-attention (open squares), control (closed circles), escape (open triangles), tangible (leisure item; open diamond), and tangible (edible item; closed diamond) conditions. Results indicate Brock's target problem behavior was maintained by escape, access to attention, tangible (leisure), and tangible (edible) items.

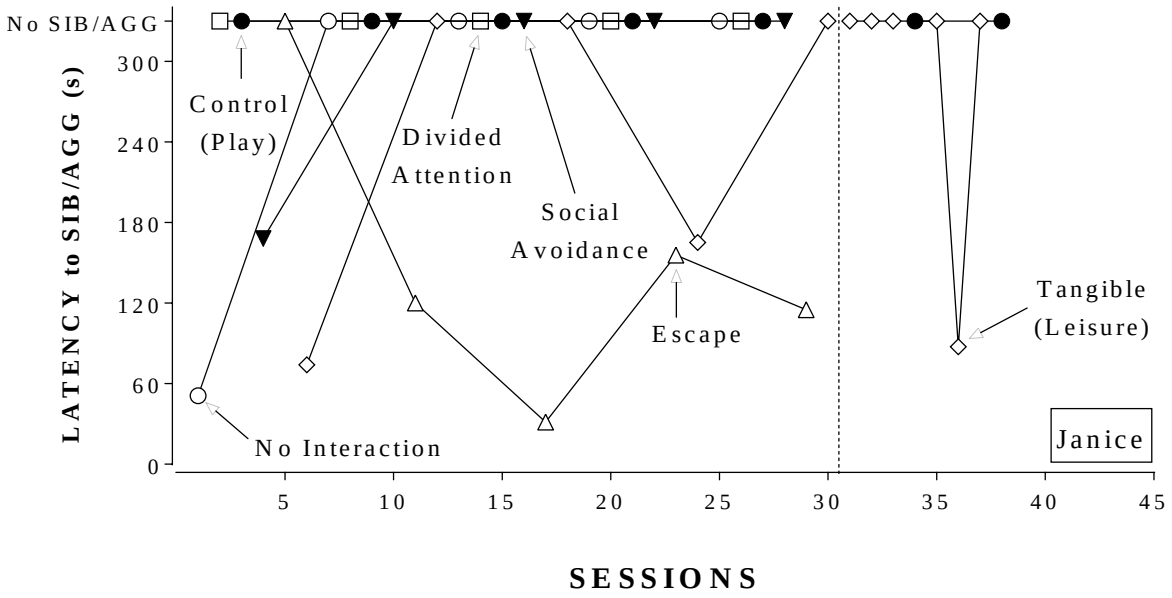


Figure 5. Latency-based FA results for Janice's physical aggression and SIB across the no interaction (open circle), divided-attention (open squares), control (closed circles), social-avoidance (closed triangles), escape (open triangles), and tangible (leisure item; open diamond) conditions. Results indicate Janice's target problem behavior was maintained by escape.

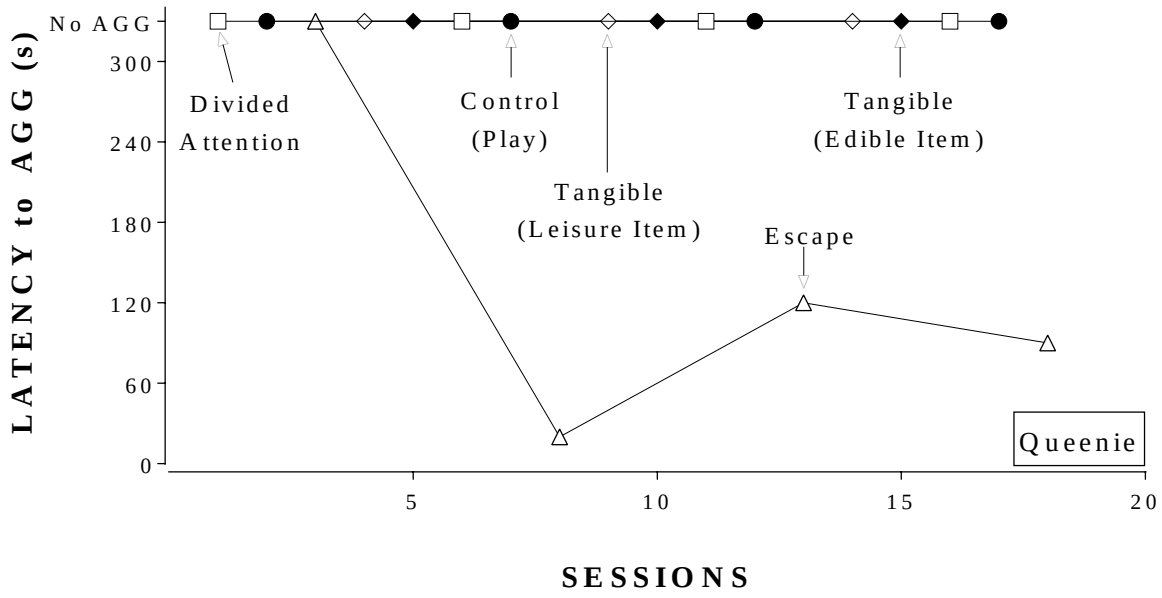


Figure 6. Latency-based FA results for Queenie's physical aggression across the divided-attention (open squares), control (closed circles), escape (open triangles), tangible (leisure item; open diamond), and tangible (edible item; closed diamond) conditions. Results indicate Queenie's target problem behavior was maintained by escape.

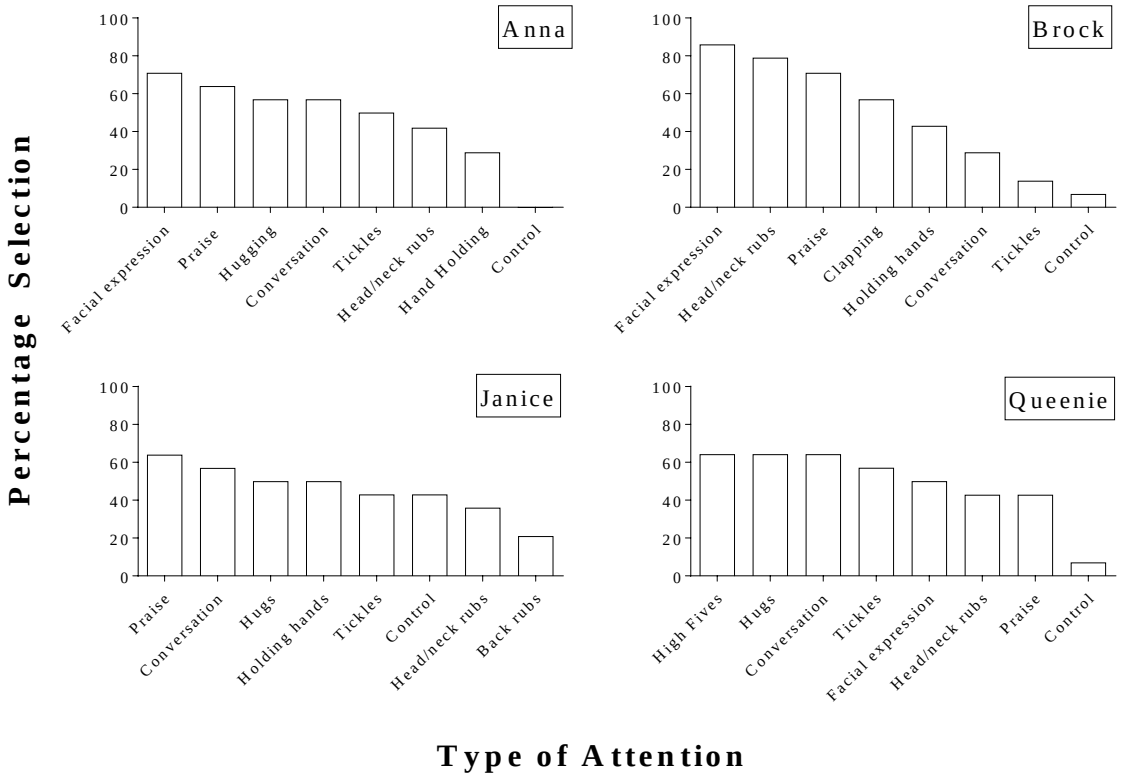


Figure 7. Attention assessment results for Anna (top left), Brock (top right), Janice (bottom left), and Queenie (bottom right). Types of attention are scaled along the x-axis and percentage of selection is scaled along the y-axis.

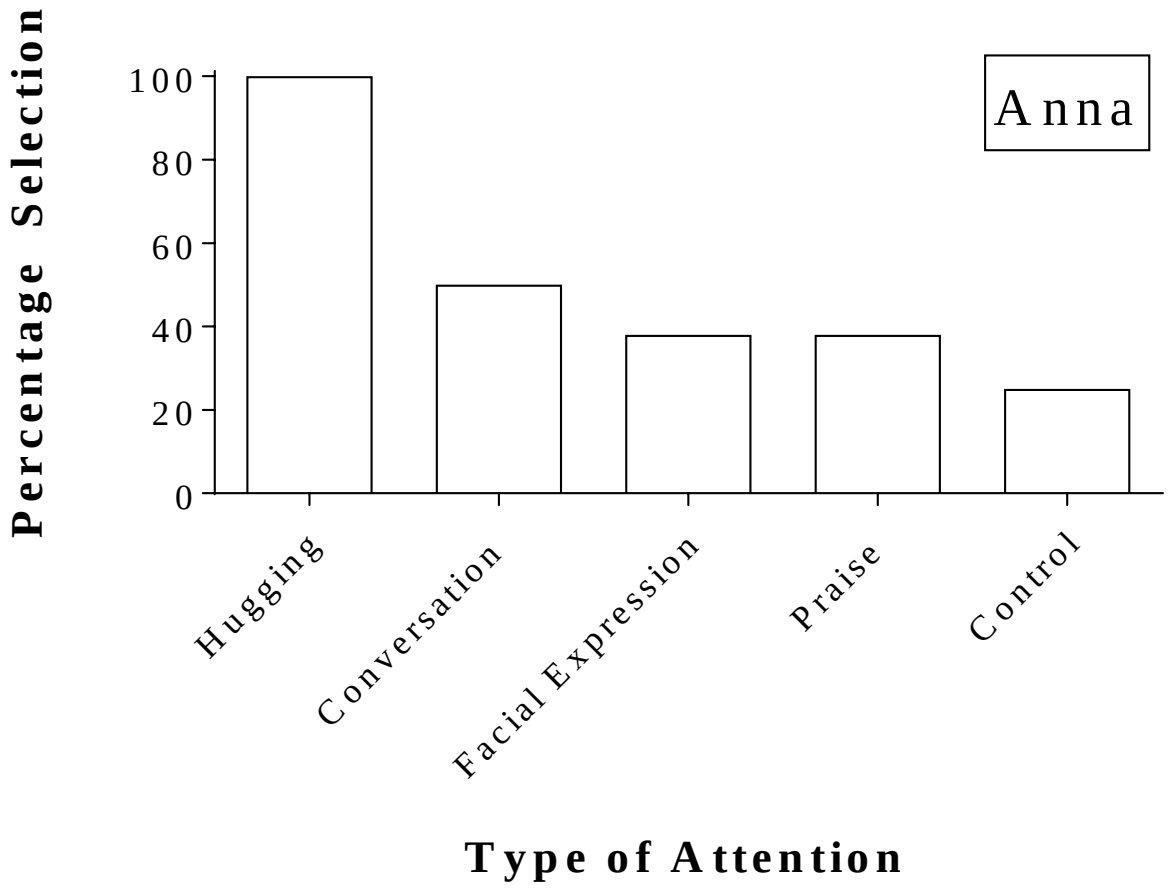


Figure 8. Second attention-assessment results for Anna. Types of attention are scaled along the x-axis and percentage of selection is scaled along the y-axis.

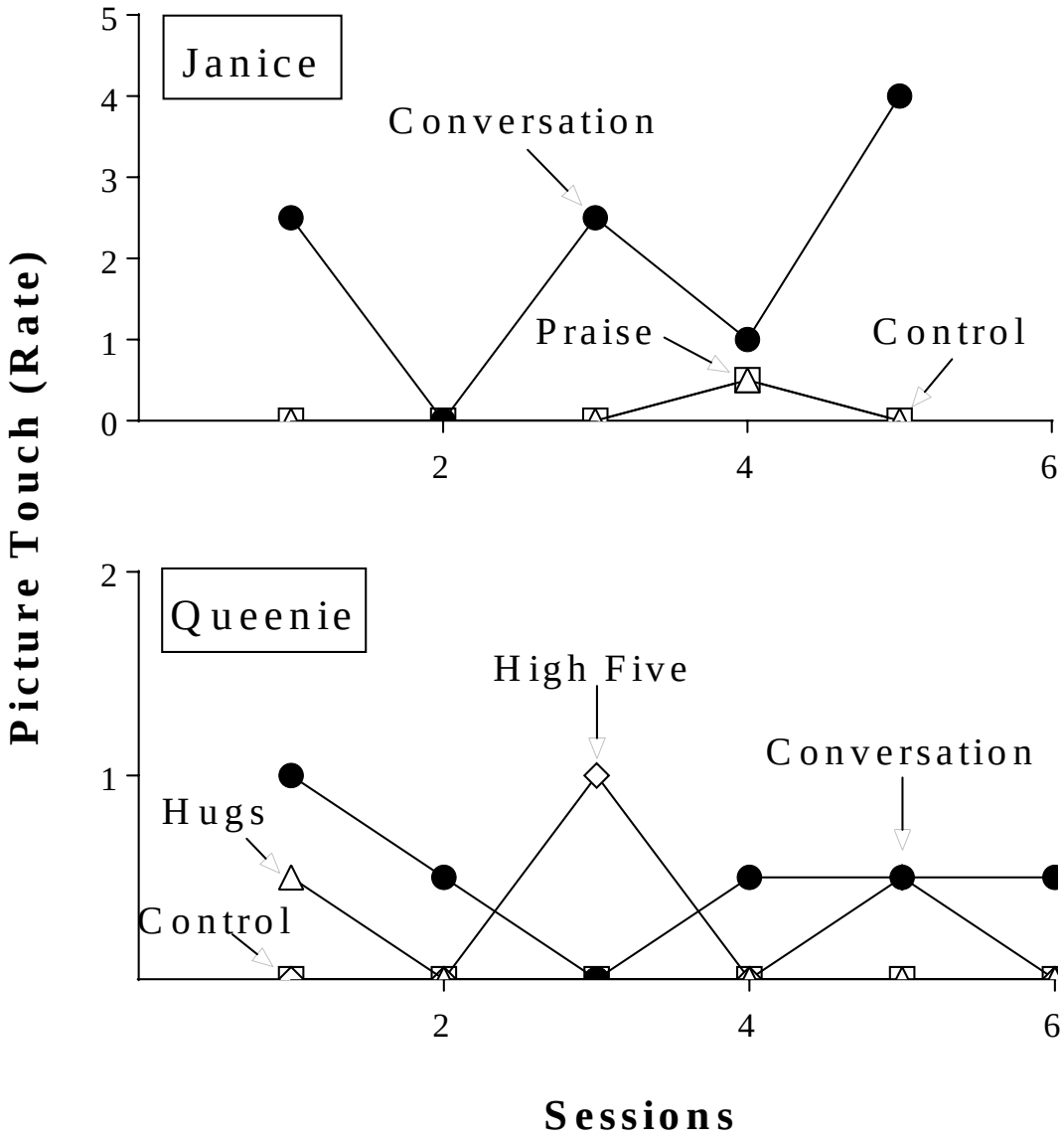


Figure 9. Reinforcer assessment results for Janice (top) and Queenie (bottom) are depicted above. Sessions are scaled along the x-axis and rate of picture touches are scaled along the y-axis.

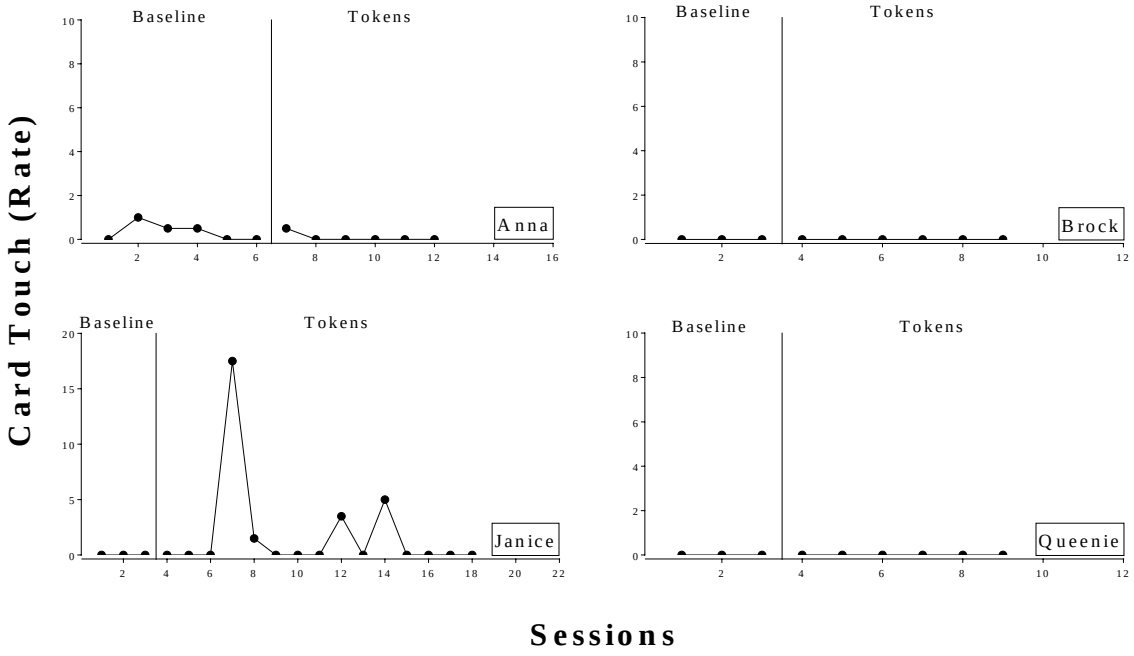


Figure 10. Results of the token assessment for Anna (top left), Brock (top right), Janice (bottom left), and Queenie (bottom right) display the rate of card touches across a baseline phase and token phase in which tokens were delivered but were not exchanged for any back-up reinforcers.

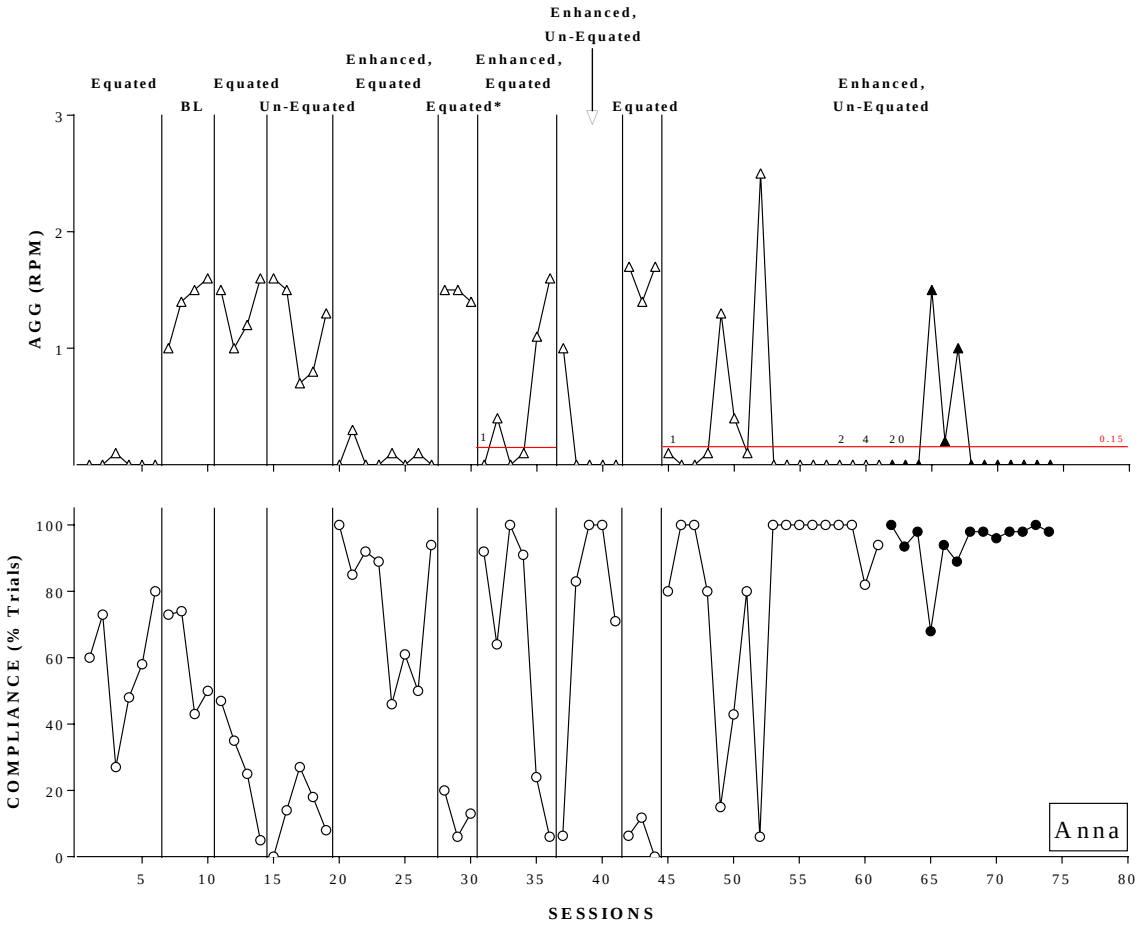


Figure 11. Results for Anna during the DRA without EXT evaluation in which schedule thinning (token exchange schedule numbers are denoted above data points) and terminal-schedule probes (closed data points) were conducted. Horizontal, red line (top panel) indicates 90% reduction of physical aggression from the control condition (denoted with an asterisk).

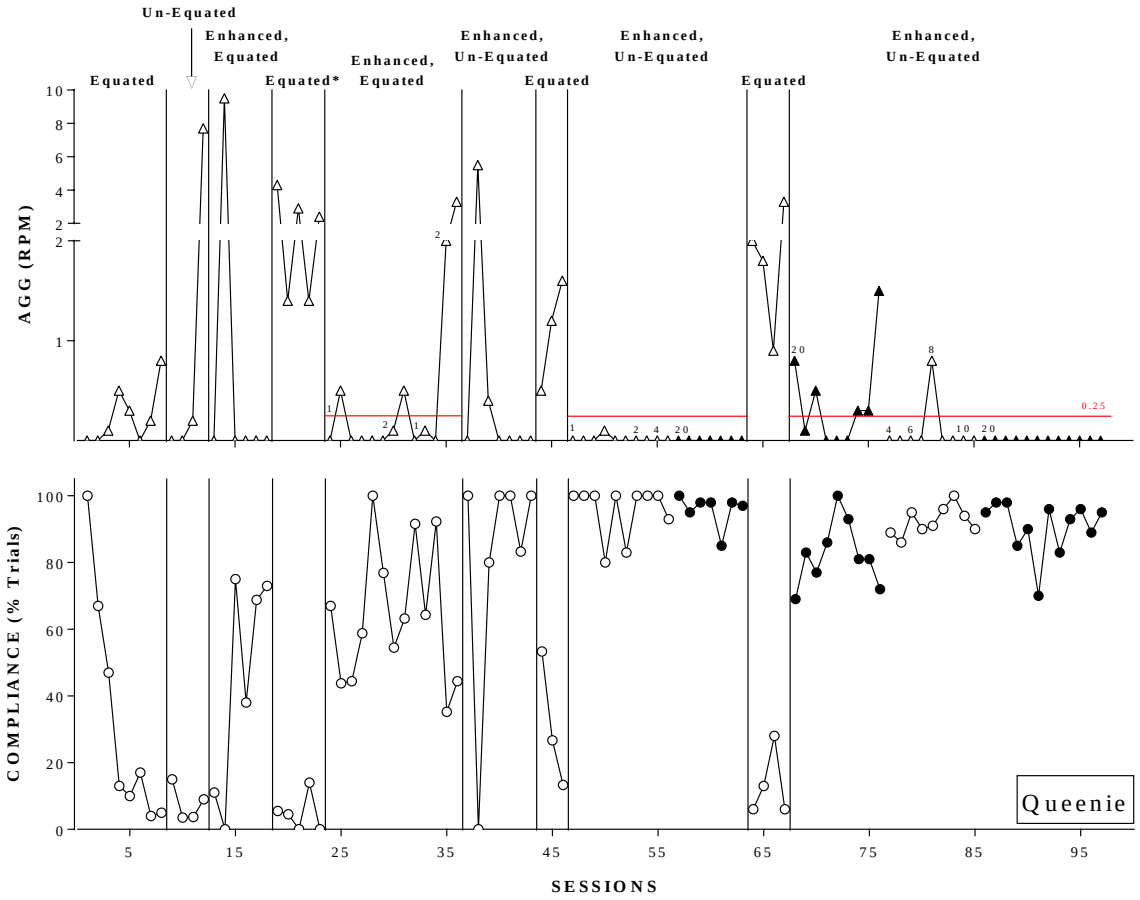


Figure 12. Results for Queenie during the DRA without EXT evaluation in which schedule thinning (token exchange schedule numbers are denoted above data points) and terminal-schedule probes (closed data points) were conducted. Horizontal, red line (top panel) indicates 90% reduction of physical aggression from the control condition (denoted with an asterisk).

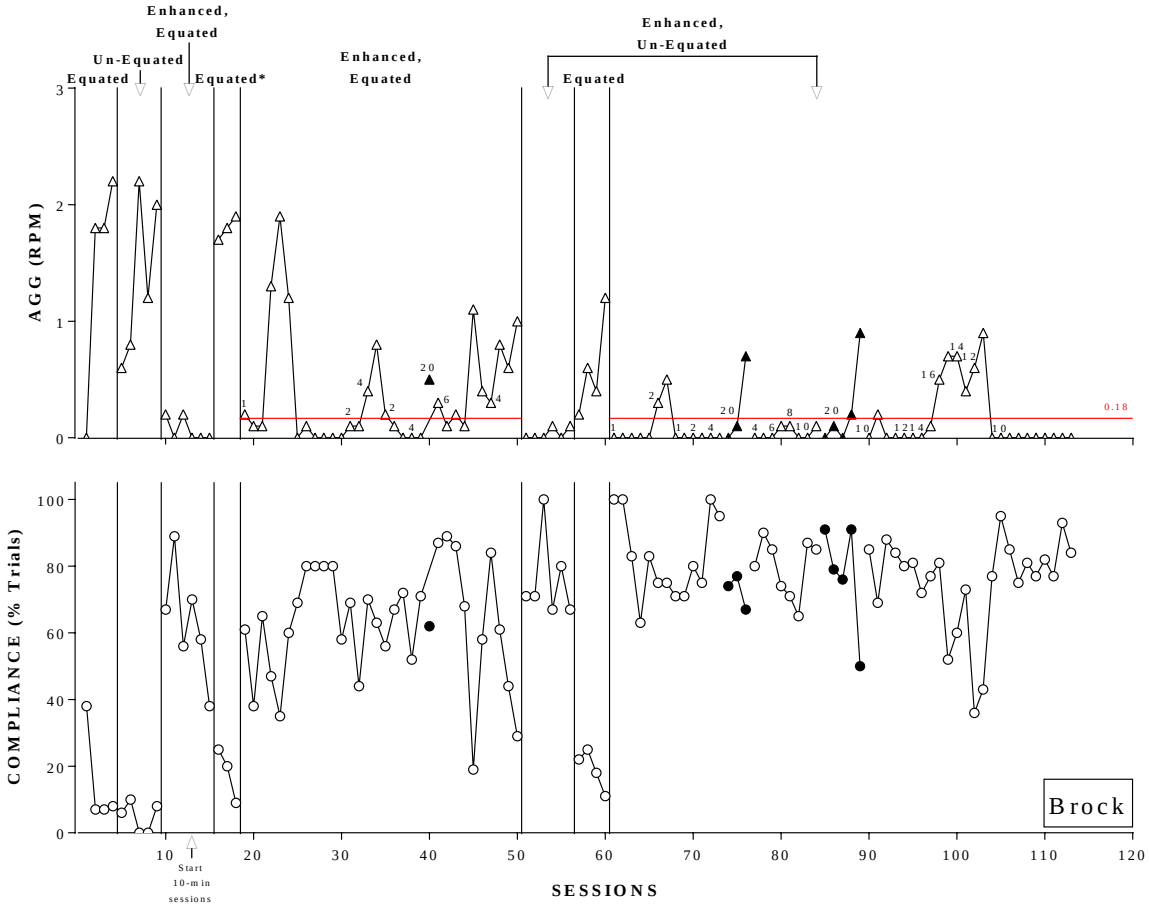


Figure 13. Results for Brock during the DRA without EXT evaluation in which schedule thinning (token exchange schedule numbers are denoted above data points) and terminal-schedule probes (closed data points) were conducted. Horizontal, red line (top panel) indicates 90% reduction of physical aggression from the control condition (denoted with an asterisk).

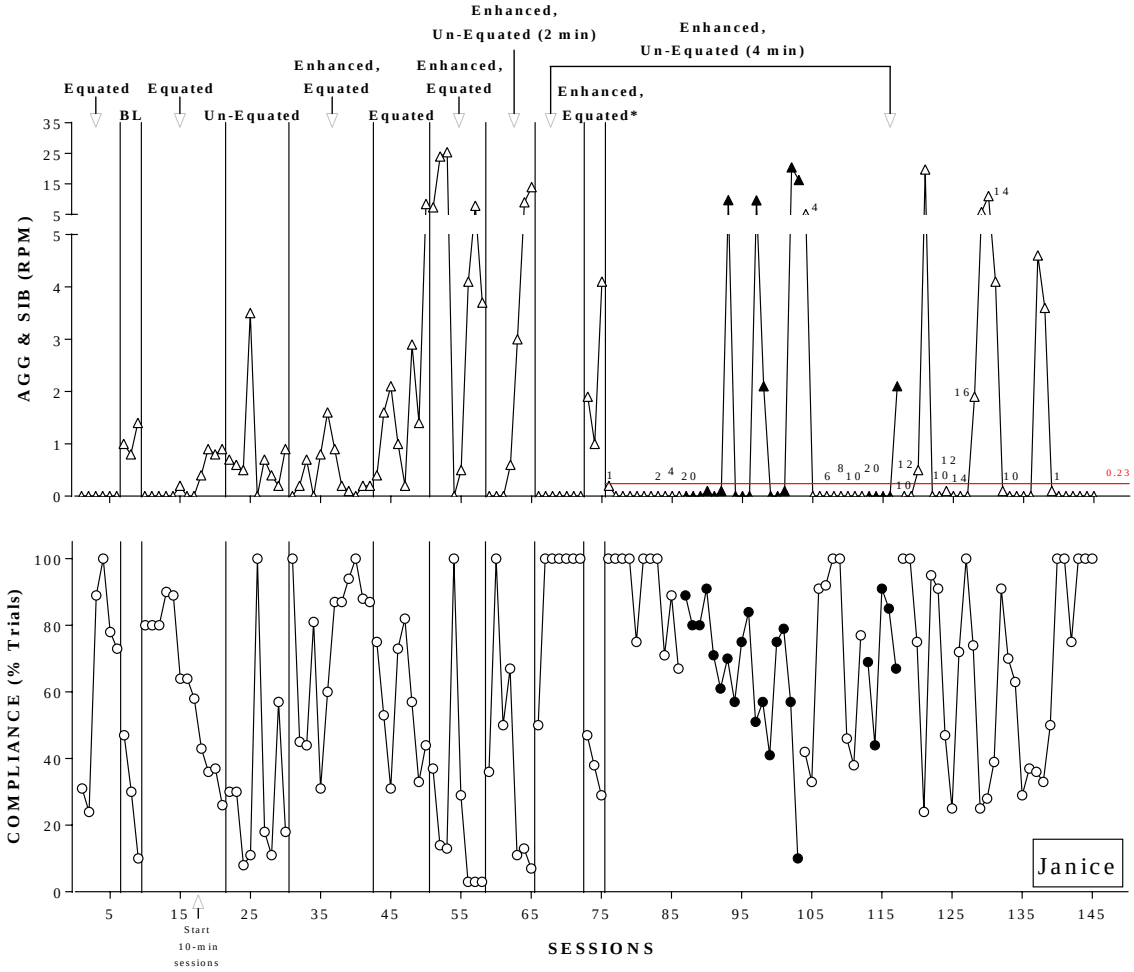


Figure 14. Results for Janice during the DRA without EXT evaluation in which schedule thinning (token exchange schedule numbers are denoted above data points) and terminal-schedule probes (closed data points) were conducted. Horizontal, red line (top panel) indicates 90% reduction of physical aggression from the control condition (denoted with an asterisk)

Appendix A

The Self-Injury Trauma (SIT) Scale

THE SELF-INJURY TRAUMA (SIT) SCALE

Patient:_____ Examiner:_____ Date:_____

PART I. GENERAL DESCRIPTION AND SUMMARY OF HEALED INJURIES

Check each type of self-injurious behavior exhibited by the patient. Next, note any physical evidence of healed injuries (scars, permanent disfigurement, missing body parts), along with the specific site.

Self-Injurious Behaviors:

___ Forceful contact with head or face
___ Forceful contact with other body part
___ Scratching, picking, rubbing skin
___ Biting
___ Eye gouging
___ Ingestion of inedible materials (pica)
___ Vomiting or rumination
___ Air swallowing (aerophagia)
___ Hair pulling (trichotillomania)
___ Other:_____

Healed Injuries:

1 _____
2 _____
3 _____
4 _____
5 _____

PART II. MEASUREMENT OF SURFACE TRAUMA

For each area of the body containing a current (unhealed) injury, identify the location and number of wounds, and note the type and the severity of the worst wound at that particular location.

Number: Score:
1)--One wound
2)--Two-four wounds
3)--Five or more wounds

Type: Abrasion or Laceration (AL): A break in the skin, either superficial or deep, caused by tearing, biting, excessive rubbing, or contact with a sharp object.

Contusion (CT): A distinct area marked by abnormal discoloration or swelling, with or without tissue rupture, caused by forceful contact.

Severity: Score AL as:
1)--Area is red or irritated, with only spotted breaks in the skin.
2)--Break in the skin is distinct but superficial; no avulsion.
3)--Break in the skin is deep or extensive, or avulsion is present.

Score CT as:
1)--Local swelling only or discoloration without swelling.
2)--Extensive swelling.
3)--Disfigurement or tissue rupture.

(scoring chart on next page)

Figure 1. The Self-Injury Trauma (SIT) Scale.

PART II (CONTINUED)

LOCATION		NUMBER	TYPE	SEVERITY	COMMENT
Head:	Scalp	1 2 3	AL CT	1 2 3	_____
	Ear L/R	1 2 3	AL CT	1 2 3	_____
	Eye L/R	1 2 3	AL CT	1 2 3	_____
	Eye Area L/R	1 2 3	AL CT	1 2 3	_____
	Face	1 2 3	AL CT	1 2 3	_____
	Nose	1 2 3	AL CT	1 2 3	_____
	Lips/Tongue	1 2 3	AL CT	1 2 3	_____
	Neck/Throat	1 2 3	AL CT	1 2 3	_____
Upper Torso:	Shoulder L/R	1 2 3	AL CT	1 2 3	_____
	Chest/Stomach	1 2 3	AL CT	1 2 3	_____
	Back	1 2 3	AL CT	1 2 3	_____
Lower Torso:	Abdomen/Pelvis	1 2 3	AL CT	1 2 3	_____
	Hips/Buttocks	1 2 3	AL CT	1 2 3	_____
	Genitalia	1 2 3	CL CT	1 2 3	_____
	Rectum	1 2 3	AL CT	1 2 3	_____
Extremities:	Upper Arm/Elbow L/R	1 2 3	AL CT	1 2 3	_____
	Lower Arm/Wrist L/R	1 2 3	AL CT	1 2 3	_____
	Hand/Finger L/R	1 2 3	AL CT	1 2 3	_____
	Upper Leg/Knee L/R	1 2 3	AL CT	1 2 3	_____
	Lower Leg/Ankle L/R	1 2 3	AL CT	1 2 3	_____
	Foot/Toe L/R	1 2 3	AL CT	1 2 3	_____

PART III. SCORING SUMMARY

A. Number Index (NI)

From Part II, add all of the scores under the Number column and enter the total here:____

	NI Score	Part II Total
(circle)	0 →	No injuries
	1 →	1 - 4
	2 →	5 - 8
	3 →	9 - 12
	4 →	13 - 16
	5 →	17 or more

B. Severity Index (SI)

From Part II, enter the frequency of scores from the Severity Column: 1:____; 2:____; 3:____

	SI Score	Severity Scores from Part II
(circle)	0 →	No injuries
	1 →	All severity scores are 1's
	2 →	One 2; No 3's
	3 →	Two or more 2's; No 3's
	4 →	No more than one 3
	5 →	Two or more 3's

C. Estimate of Current Risk Based on Location and Severity

☐ LOW → No injuries or: Any AL-1, CT-1, or AL-2 except near eyes

☐ MODERATE → Any AL-2 near eyes, Any CT-2 except on head

☐ HIGH → Any CT-2 on head, Any AL-3 or CT-3

Appendix B

Open-Ended Functional Assessment Interview

Open-Ended Functional Assessment Interview
Developed by Gregory P. Hanley, Ph.D., BCBA-D
(Developed August, 2002; Revised: August, 2009)

Date of Interview: _____

Child/Client: _____

Respondent: _____

Respondent's relation to child/client: _____

Interviewer: _____

RELEVANT BACKGROUND INFORMATION

1. **His/her date of birth and current age: ___-____-_____ ___yrs ___mos Male/Female**
2. **Describe his/her language abilities.**
3. **Describe his/her play skills and preferred toys or leisure activities.**
4. **What else does he/she prefer?**

QUESTIONS TO INFORM THE DESIGN OF A FUNCTIONAL ANALYSIS

To develop objective definitions of observable problem behaviors:

5. **What are the problem behaviors? What do they look like?**

To determine which problem behavior(s) will be targeted in the functional analysis:

6. **What is the single-most concerning problem behavior?**
7. **What are the top 3 most concerning problem behaviors? Are there other behaviors of concern?**

To determine the precautions required when conducting the functional analysis:

8. **Describe the range of intensities of the problem behaviors and the extent to which he/she or others may be hurt or injured from the problem behavior.**

T*o assist in identifying precursors to dangerous problem behaviors that may be targeted in the functional analysis instead of more dangerous problem behaviors:*

9. **Do the different types of problem behavior tend to occur in bursts or clusters and/or does any type of problem behavior typically precede another type of problem behavior (e.g., yells preceding hits)?**

To determine the antecedent conditions that may be incorporated into the functional analysis test conditions:

10. **Under what conditions or situations are the problem behaviors most likely to occur?**
11. **Do the problem behaviors reliably occur during any particular activities?**
12. **What seems to trigger the problem behavior?**
13. **Does problem behavior occur when you break routines or interrupt activities? If so, describe.**
14. **Does the problem behavior occur when it appears that he/she won't get his/her way? If so, describe the things that the child often attempts to control.**

To determine the test condition(s) that should be conducted and the specific type(s) of consequences that may be incorporated into the test condition(s):

15. **How do you and others react or respond to the problem behavior?**
16. **What do you and others do to calm him/her down once he/she engaged in the problem behavior?**
17. **What do you and others do to distract him/her from engaging in the problem behavior?**

In addition to the above information, to assist in developing a hunch as to why problem behavior is occurring and to assist in determining the test condition(s) to be conducted:

18. **What do you think he/she is trying to communicate with his/her problem behavior, if anything?**
19. **Do you think this problem behavior is a form of self stimulation? If so, what gives you that impression?**
20. **Why do you think he/she is engaging in the problem behavior?**

Appendix C

Social-Stimuli Questionnaire

Date_____ Participant_____Person filling out the form_____

TOPOGRAPHY	**Does the participant come into contact with the topography of attention in the natural environment?** **1=Never** **2=Sometimes** **3=Always**	**Is this a preferred form of attention for the participant?**
PHYSICAL WITH CONTACT		
Hugs	1 2 3	Yes or No
Tickles	1 2 3	Yes or No
Head rubs	1 2 3	Yes or No
High fives	1 2 3	Yes or No
Back pats	1 2 3	Yes or No
Hand holding	1 2 3	Yes or No
Blocking	1 2 3	Yes or No
Hands down	1 2 3	Yes or No
Physical redirection	1 2 3	Yes or No
Physical restraint	1 2 3	Yes or No
PHYSICAL WITH NO CONTACT		
Clapping	1 2 3	Yes or No
Eye contact	1 2 3	Yes or No
Facial expressions: Please list:	1 2 3	Yes or No
VERBAL		
Reprimands	1 2 3	Yes or No
Statements of concern	1 2 3	Yes or No
Warnings	1 2 3	Yes or No
Unrelated comments	1 2 3	Yes or No
Conversation about a preferred topic	1 2 3	Yes or No
Contingency review	1 2 3	Yes or No
Verbal praise	1 2 3	Yes or No
Additional Forms-please list any other forms of attention not listed above	1 2 3	Yes or No
	1 2 3	Yes or No
	1 2 3	Yes or No
	1 2 3	Yes or No

If you indicated that certain forms of attention were preferred by circling yes, please rank order the forms you circled yes for below (1=most preferred and 8=least preferred):

1	
2	
3	
4	
5	
6	
7	
8	

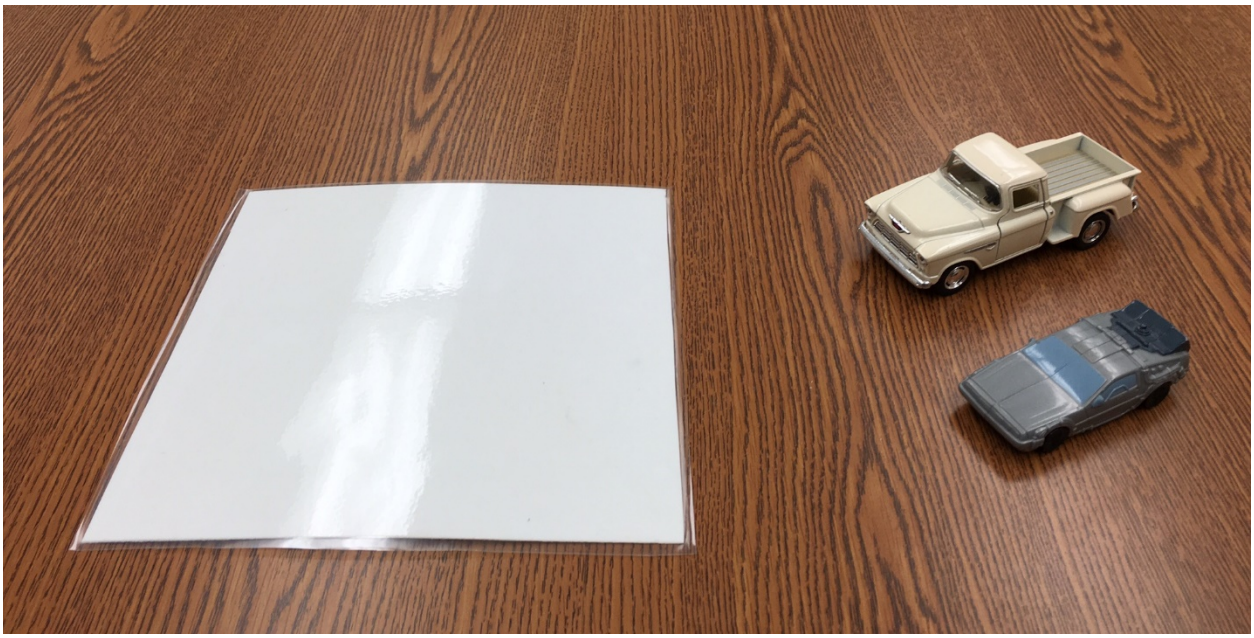
Kelly, M. A., Roscoe, E. M., Hanley, G. P., & Schlichenmeyer, K. (2014). Evaluation of assessment methods for identifying social reinforcers. *Journal of Applied Behavior Analysis, 47*, 113-135. (Supporting info retrieved from http://onlinelibrary.wiley.com/doi/10.1002/jaba.107/suppinfo)

Appendix D

Example of Pictorial Paired-Stimulus Preference Assessment Trial Arrangement

Appendix E

Example of the Baseline Arrangement of the Token Assessment



Appendix F

Example of the Token Condition Arrangement of the Token Assessment